ABSTRACTS.

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General.

1. Explosion on the Tank Barge "Two Sisters" at Keadby, Lincolnshire. Report to the Home Secretary by H.M. Inspector of Explosives. Nov. 12, 1926.

This report deals with an explosion on September 13, 1926 on a tank barge, during filling with petrol at the National Benzole Company's Depot at Keadby, as a result of which George Addinall (captain) and Nia Clarke (mate) lost their lives.

The barge, which was 62 ft. long, 15 ft. broad and 9 ft. 8 in. deep, was built of wood in the year 1893 and divided by bulkheads into three compartments, in the centre one of which were three tanks of ¼ in. steel plate fitted in October, 1923, having a combined capacity of 23,146 galls. The space between tanks was about 7 in. and between tanks and the sides of the barge about 3 in. Each tank was fitted with a 2 ft. diameter manhole, a 3 in. T-piece vent with fine wire gauze protection and two 3 in. pipes for filling and emptying. These pipes were fitted with Dewrance type plug cocks and connected to a 5 in. main running below deck to the stern of the barge. The tanks were removed, examined and painted in April, 1926. The barge was horse-drawn and not fitted with a galley stove.

The barge was moored about 18 ft. from the bank of the canal and connected by a 5 in. flexible hose with the National Benzole Company's pump house and tanks. Connection between the flanged ends of the hose and the 5 in. main at the stern of the barge was made by means of two iron clamps held together by bolts and nuts. The packing between joints was of compressed cardboard. Other joints in the 5 in. main were similarly secured.

Petroleum spirit, specific gravity ·745/60° F., was pumped into the aft tank, and the joint between the flexible hose and the 5 in. main found in order. Later, petrol was observed leaking from one of the cocks on the aft tank and the pumps stopped.

George Addinall placed his foot on the leaking valve and called for the pumps to be restarted, but before this could be done an explosion occurred and fire broke out on the barge. The fire was extinguished by Foam type extinguishers and the bodies of Addinall and Clarke recovered.

The forward part of the barge was blown out, the forward tank was blown in, the deck was lifted in places and the 5 in. main was wrenched from its connections and lost overboard. It was recovered later and found to be still firmly attached to the flexible hose. The amidships tank was empty

and undamaged and the aft tank contained 2750 galls. of petrol: 3267 galls. of petrol had been pumped from the depot.

Leakage of petrol had apparently occurred from one of the valves on the aft tank. This valve, and also one on the forward tank, had previously undergone a temporary repair, which was not quite petrol-tight, and in addition the gland had been removed, thus allowing pressure in the pipe to lift the plug from its seating. It was the custom of Addinall to hold the valve down with his foot when leakage occurred. The petrol leaking from the valve would collect in the barge and its vapour could form an explosive mixture in the holds.

Possible causes of ignition were:—

1. A spark from a passing barge or barge moored nearby.
2. A lighted cigarette or match thrown down on the towpath 18 ft. away.
3. A spark from railway sidings 53 ft. away. (Nearest locomotive in steam at the time 70 yds. away.)
4. Smoking on the barge.
5. A spark from a motor engine on the tow-path 18 ft. away.
6. A spark from either of two dwelling-houses about 36 ft. away.
7. A spark produced on the barge by some means.

In consideration of the evidence Nos. 6 and 7 are the more probable causes, and the author inclines to No. 7, and suggests that, having trouble with the valve, Addinall struck it sufficiently hard with his boot to strike a spark with one of the nails in the sole.

The author considers the accident was due to neglect by the owners of the barge in failing to remedy the defect in the cock which had been brought to their notice in April, 1926, and on subsequent occasions.

Observations:—

1. Barges constructed of steel are more suitable for the work than those of wood.
2. Tanks should have sufficient surrounding space to permit inspection without removal. This would also give greater protection to tanks in case of collision.
3. The Dewrance type plug cock is not suitable for this work as it tends to leak if the gland is not tight and is very difficult to turn unless gland is slack. Ham Baker type gate valves have been found successful in many cases.
4. Joints between flanged pipes would be more secure if fastened with bolts in the normal way instead of with clamps.
5. This barge was unattended during part of the filling time. Some competent person should be on the barge while filling and have means of communicating rapidly with the pump house.
6. Manhole covers should be kept firmly closed until everything is ready for pumping to begin.
7. Rules and regulations should be posted in barges. In this case only a notice prohibiting smoking on board was exhibited.
8. Site appears unsuitable for loading barges, although the storage tanks are safely situated.

Recommendations:—

1. The Canal Company should make suitable Petroleum bye-laws and, if they can, require licences to be obtained for tank barges conveying petroleum spirit on waterways regulated by them.
2. The practice of loading tank barges with petroleum spirit on the site where the accident occurred should be discontinued.

E. R. B. S.

2, Impregnating Wood with Paraffin. L. W. Eberlin and A. M. Burgess. *Ind. and Eng. Chem.*, Jan., 1927.

This work was undertaken with a view to obtaining an impregnated wood which would withstand the action of acids and alkalies, as regards swelling.

Various woods were impregnated with cresol, vaseline, paraffin oil, linseed oil and paraffin, both singly and in various combinations, some of the woods having been first soaked, some dried and some extracted to remove resins.

It was found that the best results were obtained by soaking the wood in water for at least twelve hours before impregnating. The impregnation is done in open tanks and the procedure which gave best results by using paraffin wax is described.

The wood is immersed in a bath of molten paraffin at 71° C. and the bath is raised in temperature to 105° C. during 30 minutes, followed by a further increase to about 135° C. during 3 to 4 hours. Treatment at this temperature is continued until all effervescence, due to escapement of steam, has ceased. The wood is now withdrawn to another bath at 71° C., when it stands for 30 minutes, after which it is removed and freed from excess impregnant.

The authors attribute the success of this method to the gradual increase in temperature, and find it equally suitable for both close and open-grained woods. A. R. S.

3. Aero Engine Fuels of To-Day and To-Morrow. Colonel The Master of Sempill. Paper before Royal Aeronautical Society, Oct. 7, 1926.

In dealing with the history of petroleum products, the author refers to Magara, who in about 1600 distilled oil and sold the distillate as an illuminant, this probably being the first attempt to split up crude oil into its components.

The question of available petroleum supplies is always one for speculation and an official report recently issued by a competent authority in the U.S.A. places available domestic stocks as sufficient for a very short period. Great doubt exists as to the length of life of existing fields and although new fields will undoubtedly be opened, no forecast as to their location or production can possibly be made. Complete drainage of the fields cannot be visualised as probably only 35 per cent. of the oil present is brought to the surface.

Petroi is to-day the most important petroleum product and it has been said that petrol pays for the crude oil, kerosene for refining, fuel oil for marketing and lubricating oil for profit.

The average American crude yields, without cracking, about 50 per cent. gas and fuel oils, 25 to 30 per cent. petrol, 10 per cent. kerosene, the remainder being lubricating oil, paraffin wax, asphalt, etc. Crude oils may be roughly divided into two classes, paraffin-base with a relatively high percentage of aliphatic hydrocarbons, and asphalt-base with a high content of cyclic hydrocarbons, the latter class yielding the best aviation spirit.

The most important property of aviation spirit is its Highest Useful Compression Ratio, beyond which any increase results in detonation and loss of power. From the standpoint of anti-detonation, aromatic hydrocarbons are the best, followed by the naphthenes and paraffins. The boiling range is also of importance and there are various tests to indicate the presence of undesirable constituents.

The calorific value of fuels varies considerably, petrol averaging 19-20,000 B.Th.U. per lb., alcohol, 11-12,000 B.Th.U. and Benzol 17-18,000 B.Th.U. When considered from the point of B.Th.U. per gallon, the fuels composed

mainly of naphthenes and aromatics have an advantage, as the following figures of Ricardo show :—

Sp Gr.	B.Th.U. per lb.	B.Th.U. per gallon.
0·704	19,250	135,500
0·727	19,120	137,000
0·760	18,800	143,500

The following are also from the same source :—

	Sp. Gr.	B.Th.U. per lb.	B.Th.U. per gallon.	% excess H.U.C.R.	Total increase in efficiency.
Petrol, mainly paraffins	0·705	19,130	134,866	— 4·6–1	—
Petrol, mainly naphthenes and aromatics	0·785	18,450	144,832	7·4 5·8–1	22%

Three B.E.S.A. specifications exist for petrol, their general characteristics being :—

A. Motor Spirit.

I.B.P., 55° C.; 20% over, 105° C.; F.B.P., 225° C.

B. Aviation Spirit.

Sp. Gr.	Boiling range.		Aromatic Content.	Toluene Equivalent.
0·720	75° C.	10%		
0·740	100° C.	60%	12–20%	10%
	140° C.	95%		

C. Aviation Spirit.

0·760	75° C.	10%	
0·790	100° C.	50%	35% 28%
	150° C.	90%	

Various tests show that a high percentage of low-boiling constituents is undesirable in aviation spirit owing to the possibility of gas locks in the flow lines at altitudes.

Casing-Head Spirit.—The yield per 1000 cubic feet of gas averages from two to three gallons, the spirit consisting largely of low-boiling hydrocarbons of the paraffin series. The U.S. Bureau of Mines gives distillation figures showing : I.B.P., 31° C., 50 per cent. over, 61° C., and F.B.P., 143° C.

Straight-Run Spirit.—Apart from doping, a spirit of the asphalt-base class will give the best results. This means the use of high-gravity spirit and serious consideration is desirable as to the use of dopes in low-gravity spirits with a view to weight saving in aircraft.

A knowledge of the chemical composition of any petrol is essential, but does not necessarily give any data as to its suitability. The following figures, obtained with the Ricardo Variable-Compression Engine, are of interest :—

Approximate Composition. Paraffins.	Naphthenes.	Aromatics	H.U.C.R.	Temperature.	Consumption. B.H.P.
62	23	15	5·7	422° C.	0·435 pts.
68	20	12	4·7	387° C.	0·484 pts.

The difference in compression ratio between two fuels of similar composition may be due to there being no accurate method for naphthene determination or that little is known of the composition of paraffins likely to promote detonation. The advantages of using the highest possible compression ratio are evident.

Cracked Spirit.—There is evidence to show that the H.U.C.R. of a cracked spirit from a given crude is superior to a straight-run spirit. Tests made on a spirit cracked from Russian kerosene gave an H.U.C.R. of 5·78 and 5·79, and with the ratio fixed at 4·5 the consumption per i.h.p. hour was 0·458 pint, as against 0·475 pint for an A aromatic free petrol.

Shale-Oil.—A characteristic of shale-oil is the high percentage of unsaturateds. The particulars of a Scottish oil-shale petrol are:—Sp. Gr., 0·728; I. B.P., 43° C.; F.B.P., 168° C.; Distillation, to 75° C., 7 per cent., to 100° C., 44 per cent., to 125° C., 81 per cent., to 150° C., 95 per cent.

Benzol.—Benzol is composed chiefly of aromatics, benzene, toluene and xylene being the essential constituents. In its undiluted state, benzol has a freezing point two high (—14° C.) for aviation purposes. The freezing point of an 80/20 petrol/benzol mixture is about —45° C., and of a 50/50 mixture about —20° C. Military aircraft may often fly at such heights that temperatures below —45° C. are met, but tests show no serious effect for the time aircraft would normally remain at such heights. Tests by Ricardo found toluene to have the best anti-detonating effect and led to the adoption of the term Toluene Value.

Naphthalene.—Professor Schroefer's hydrogenation process has resulted in the production of two compounds of naphthaline, tetralin and decalin, with an intermediate, tetralin-extra. Tests by Sir F. Nathan gave satisfactory results when using not more than 50 per cent. of tetralin mixed with petrol. Tetralin-alcohol and tetralin-benzol mixtures have also been used with success.

Low-Temperature Carbonisation.—A sample of spirit from the Low Temperature Carbonisation Company's experimental plant was tested, and the H.U.C.R. found to be 6·5 to 1. The average yield of light fuel for this process is 1·0 to 1·6 gallons from residual oil and 2·0 to 3·8 gallons from gas per ton of coal carbonised. Distillation figures are: I.B.P., 44° C., 70 per cent., 100° C., F.B.P., 144° C.

Hydrogenation.—Bergius claims to convert 65 per cent. of certain coals into oil, 25 per cent. of which is light fuel. The ultimate yield of light fuel would be about 15 gallons per ton of coal, but several years must elapse before commercial data is available.

Alcohol.—The H.U.C.R. of alcohol is 7·5 to 1. The water-content of commercial alcohol allows high M.E.Ps. and its high latent heat explains its anti-detonating quality. Tests on ethyl alcohol of 90 and 99 volume per cent. gave the following results in regard to power output:—

C.R.	99%	90%
3·8 to 1 ..	27·5 ..	26·6
5·0 to 1 ..	32·2 ..	31·6

The use to which alcohol will be put is in forming mixtures with various fuels and here the water content, usually not less than 5 per cent., proves a difficulty. As an example, a petrol-alcohol mixture of 100/10 by volume will be thrown out of solution with less than 2 per cent. of water in the alcohol.

A large number of substances have the effect of raising the H.U.C.R. of the fuel to which they are added. Of the organo metal compounds, "lead

tetra ethyl" is the most remarkable. Used alone, this compound had a bad effect on the lubricant and deposited salts of lead on valves, etc. The addition of ethylene dibromide was made to cure this, the mixture (ethyl fluid) being used in the ratio of 5 c.c. per gallon. Tests of ethyl fluid show that the halogen compound has a beneficial effect on the H.U.C.R., although the value obtained from a definite quantity of ethyl fluid, say 10 c.c. per gallon, appears to bear no relationship to the original value of the fuel, as follows:

Fuel	H.U.C.R. Fuel alone.	Fuel, plus, 10 c.c. Ethyl Fluid.
"Power"	5·8 ..	7·3
Shell "Aviation"	5·8 ..	7·3
Shell No. 1	5·5 ..	7·0
Pratt's No. 1	5·4 ..	6·8
Bluebird No. 1	5·2 ..	6·6

Metallic Sols.—Tests with fuels to which were added colloidal sols of iron, lead, nickel, etc., show these to be as effective as the organo-metallic compounds.

Nitrogen Compounds.—The aromatic amines are about ten times as efficient as toluene as anti-detonators. Of the toluidine group, m-toluidine proved superior at high concentrations. Similarly, m-Xylidine proved the most desirable in the xylidine group. In the aniline group, a wide range of compounds were tested and mono-methyl aniline is slightly superior to aniline. The following table shows the percentage increase of H.U.C.R. obtained with petrol plus 5 per cent. by volume of organic substances, comparative figures for certain hydrocarbons being also given:—

Substance.	Chemical Formula.	Boiling Point.	Effect on H.U.C.R.
Benzene	C_6H_6 ..	80° ..	1·0
Toluene	C_7H_8 ..	111° ..	2·0
Xylene (o)	C_8H_{10} ..	143° ..	0·6
Aniline	C_6H_7N ..	184° ..	+21·7
Methyl-Aniline ..	C_7H_9N ..	194° ..	+22·2
Ethyl	$C_8H_{11}N$ ..	204° ..	+10·4
Toluidine	C_7H_9N ..	200° ..	+18·3
Xylidine (m) ..	$C_8H_{11}N$ ..	215° ..	+22·3
Cresol	C_7H_8N ..	190° ..	+ 5·8
Phenol	C_6H_6N ..	181° ..	+ 4·4

Detonation.—No adequate explanation yet exists of detonation, although exhaustive research has been made on the problem. The liability of fuels to detonate, as given by H.U.C.R. values, determines their efficiency in use. Apart from the character of the fuel, engine design plays an important part, and it is said that there are sixteen variables to be reckoned with.

The author concludes that the forecast of the fuel position of the immediate future lies in the fulfilment of (*a*) research on engine design and its bearing on the use of fuels, (*b*) the discovery of a suitable anti-detonator dope, (*c*) the extension of cracking to yield more light fuel, (*d*) the improvement in means of producing light fuels from coal, and (*e*) the creation of methods of alcohol supply, either by fermentation or synthetically. G. S.

4. Oil Industry and State. A. Serebrovsky. *The Mining Journal*, Dec., 1925, No. 12, p. 1021.

The Government of the U.S.S.R. controls all industries, issuing instructions on the scale and direction of its work.

The larger the branch of industry, and the more important its meaning for the Soviet people's economy as a whole—the more strongly does the Government express itself in this directing and controlling role.

It follows therefore that, the oil industry, supplying fuel and oil products to the country, as well as exporting up to 100 mill. poods of oil products, is directed and controlled by the Government to the highest degree.

On the other hand the oil industry is a large source of income to the Government, paying it, as owner of the earths interior, the dole-share on each pood of oil produced, taxes, and a deduction on profits.

How great these amounts can be seen when N.K.F. demands from Azneft 21,2 million Rbls., from Grosneft 15,2 and from Embaneft 2,4 million Rbls. If to these amounts are added 5,2 million Rbls. demanded from the Neft syndicate and 35,4 million Rbls. expected excise duties, then the total is 80 million Rbls. in round figures.

The nationalization of the oil industry in 1920 found the Baku oilfields with a fallen production, drilling down to zero, and a significant reserve of oil and oil products. This reserve gradually disappeared, and Azneft remained a half dead industry with a monthly production of 10-12 mill. poods, and only on the introduction of the new political economy did the Soviet oil industry begin to rise slowly.

During this period of resurrection the Government did not relax their economical demands but increased them—if formerly they requested more oil products for the country, to this they have now added the further condition to supply oil at a cheapened rate, and on a par with extending the industry, to reconstruct it in accordance with the latest attainments of the worlds oil technology.

N.K.F., in agreement with the highest organs, present to the Oil Trust ever increasing demands—to pay taxes, to repay advances, to deposit deductions from profits, and to pay in rents due from the Trust for occupied oil lands.

The oil industry was forced to supply fuel to the Railways and War Ministry at a planned price, several copeecs cheaper than self cost, Azneft losing, by this means 2 mill. Rbls. in 1924-25, and for the current year having repealed the planned price, Government has obliged the oil industry to allow a 3 per cent. discount off the established price to all the planned consumers.

The repayment of advances made to the oil industry in 1922 is demanded, while at the same time the debt of the N.K.P.S. for fuel supplied is annulled.

The correct, full and uninterrupted supply of oil and its products to all branches of the U.S.S.R. economy is one of the first conditions of the oil industry's progress.

Oil is wanted for the country and for export to exchange abroad in purchasing and importing the necessary machinery and goods.

All these reasons advance the problem of acceleration and maximum progress of oil production and its distillation.

Taking into account the exhausted state of the Baku oilfields, now-a-days seriously impeding the increase of production, the lower purchasing power of the Chervonetz as compared with the pre-War Rouble, and the additional task of reconstruction and technical renewals of the oil industry, it must be acknowledged that the imminent increase in production, by Azneft, of

150 mill. poods during the ensuing five years should be accompanied by an inflow of capital of not less than 250 mill. Rbls.

But the State, leaving out of consideration the original advance—the repayment of which is now demanded, does not put new capital into the oil industry.

The State gives to the coal industry, which has also greatly to enhance its production, irrevocable and long term advances and opens credit from loans of the economical renewals.

So far as the oil industry is concerned such measures are not applied, but on the contrary, the pressure from the N.K.F. is augmented.

The only source from which the oil industry can obtain the necessary means is from its own gains.

These gains are not great, but it can be confirmed that with favourable conditions and by great efforts the oil industry can consider it possible to fulfil the five years programme by means of its own gains. But it is necessary *that the N.K.F. curtail to a minimum its demands for repayment of taxes, deductions from profits, etc.*

The oil industry does not intend to state that the payment to the Government of all monies legally due is not its infallible and first duty. With nominal conditions and a steady growth the oil industry would be the most accurate paymaster and the most punctual debtor.

The financial estimates of Azneft foresee the payment to N.K.F. the dole-share of production at the rate of 2 cop. per pood, total 6,6 mill. Rbls., which together with the repayment of advances of 1,5 mill. Rbls. amount to 8,1 mill. Rbls. on condition that income tax is postponed for a year. N.K.F. has now demanded an increased dole-share up to 3,5 cop. per pood, an increased repayment of advances up to 3 mill. Rbls., totalling 21 mill. Rbls., instead of 8 mill. Rbls.

The situation is too serious, the significance of the oil industry is too important for itself, and for the State as a whole, not to demand a full definition of the financial question in relation to the State and oil industry.

To reach the height to which the oil industry of U.S.S.R. is now forced, can only be done if it is assisted with the necessary means in some way or other.

T. W.

5. Our Mineral Resources, their Exploitation and Possible Perspectives. W. Kisselnikov. *The Russian Mining Journal*, Jan., 1926, No. 1, p. 3.

The reserves of petroleum in the interior of the territory of the Union are calculated at, approximately 2 milliard tons and compose about 20 per cent. of the whole world's reserve of this mineral. In the following years it is proposed to produce 8-10 mill. tons yearly.

There are many districts as yet only touched by investigation which, judging from information on hand, can confidently be depended upon to open up fresh great oil beds. Of such districts too well known to mention, the possibility can be definitely stated of their producing 10-20 times more petroleum than their present yield.

And there can be no doubt that the rate of further growth of the oil industry, during the next ten years will be defined, not by the reserves of the oil beds, but by the amount of expenditure in prospecting and exploitation, drilling and equipment of oil fields which may be put into the business during the time stated.

A programme of systematic prospecting in the more promising oil bearing districts costing about 3½ mill. Rbls. was projected by the "Geolkomon,"

but nearly the whole amount was struck out by the higher authorities. The question of this prospecting work is likely soon to receive a confirmatory decision. T. W.

6. The Impossibility of Increasing Baku Production. (No author). *The Petroleum Bulletin*, Aug. 1st., 1926, p. 10.

According to the 5 years' hypothesis of the development of the petroleum industry the production in the Baku district for 1926-27 should reach 6·49 million tons and drilling 231,000 metres, 199,500 m. exploitation drilling and 31,500 prospecting. The directorate of Azneft considers this plan, as far as production is concerned, entirely unrealisable, stating that the maximum production, for the ensuing year, can, in no instance, exceed 6·24 million tons.

The difference of 0·25 million tons is explained by Azneft as follows. O.S.W.O.K. estimated the ensuing year's production at 6·49 million tons (396 million poods) basing this amount on the production of the last month —September—of the current year, when Baku production should reach 0·53 million tons (32·4 million poods). As this amount will not be reached, it cannot be accepted as a basis in estimating the ensuing year's production and would mean concentrating all drilling work exclusively on the most prolific Baku areas Surachani and Bibi-Eibat. Such a policy, notwithstanding its known injuriousness, would still not yield the expected results. By concentrating drilling on the richer areas, Azneft, in the near future, would obtain an exceedingly cheap petroleum, but having quickly exhausted these areas, they would, in the subsequent years, be forced to return to the already exhausted area, and obtain an intolerably dear petroleum. An excessive density of wells on the richer areas, would unavoidably lead to a smaller average well production. The concentration of drilling in Surachani and Bibi-Eibat is also not conformable as these areas do not yield lubricating oils, the demand for which is still rising both on the internal and external markets. The necessary drilling rigs also could not be moved from their present position until the present drilling is completed—a matter of 6 months —and therefore the result could only be known towards the end of the ensuing operation year. The production of 6·49 million tons is also non-conformable as the Azneft refineries are not in a condition to refine more than 3·85 million tons, while according to the estimate of the O.S.W.O.K. and Z.U.G.P.R.O.M. these refineries should distill 4·18 million tons. The amount of production estimated by Azneft agrees with the estimate of the Geological Prospecting Bureau. T. W.

7. The Azerbaidjan Oil Industry in January, 1926. General News, *The Azerbaidjan Oil Industry*, Feb., 1926. No. 2, p. 101.

Production.—The Baku gross oil production for January was 430,954 tons.

In relation to methods employed, bailing produced 32·6 per cent., compressor 24·5 per cent., deep well pumps 28·4 per cent., fountains 12·9 per cent., and collected from pools 1·6 per cent.

A comparison shows that the number of deep well pumps has largely increased to the disadvantage of bailing, which latter method last year was responsible for 54·3 per cent. of the gross production.

Drilling.—The total rigs in use at the commencement of January were : 77 rod drilling rigs, by cable 51, and rotary 112. During the month 11 rod drilling rigs, 26 cable and 22 rotary were brought into use. 30 wells were completed and 9 rigs, for various causes, were stopped.

The total metres drilled, with the percentage fulfilled of the estimated programme are :—

Method.	Metres.	% Estimated Programme.
Rod drilling	3,082·2	111·8
Cable „ ..	4,111·1	139·5
Rotary „ ..	9,643·1	139·8
Total ..	16,836·4	133·6

This amount of drilling constitutes a record. In the preceding year rod drilling was responsible for 55·3 per cent. of the total amount drilled, rotary 43·5 per cent., and cables 1·2 per cent., having only just been introduced. For the first 4 months of the current operating year, October to January, 57·4 per cent. of the drilling was done by rotary rigs, 18·3 per cent. by cable rigs, while rod drilling has decreased to 24·3 per cent.

T. W.

8. The Oil Industry in U.S.S.R. General News. *The Azerbaidjan Oil Industry*. March, 1926. No. 3, p. 121.

Grosny.—The production of oil and gas for the first quarter of the current year was 569,131 tons. This is an increase of 12·7 per cent. on the corresponding quarter of the preceding year.

The expenditure for fuel was 10·9 per cent. of the gross production as against 11·2 per cent. in the first quarter of the foregoing year.

The drilling in metres for the first quarter was :—

	Old Area.	New Area.	Vosnitsensky.
Rod system ..	11,348·1	2,610·2	630·8
Rotary „ ..	956·7	1,901·1	—
Total ..	12,304·8	4,511·3	630·8

The gross amount being 17,446·9 or 68·5 per cent. above the first quarter of the previous year.

The production for February month was from the old area 75,386·8 tons, from the new area 85,296·8 tons, total 160,683·6 tons, a decrease of 2·2 per cent. on January month. Fountain wells gave 64 per cent. of the gross production.

Fuel used amounted to 19,269.2 tons—12 per cent. of the gross production.

Drilled for February by rod system 2782 m., rotary system 1320 m., a total of 4102 m.

The Grosny oil industry and the Kuban-Black Sea oil industry are to be amalgamated under one Trust and the desire has been expressed to name it "Sevkavneft."

Emba.—The gross production for January on the Ural-Emba district amounts to 17,625 tons, an increase over December of 455 tons or 2·5 per cent. This increase over December is observed on Dossor 141 tons, and on Makat 244 tons. Fountain oil produced 278 tons more than in December and compressor wells 288 tons. Deep well pumps gave a decreased yield of 185 tons, and bailing wells 180 tons less.

364 m. were drilled in January as against 320 in December.

On the Makat oilfields 13 of the old wells are now working; the remaining 6—less productive—will be in exploitation during February–March. T. W.

9. The Baku Oil Chronicle. General News. *The Azerbaidjan Oil Industry*. March, 1926. No. 3, p. 128.

The Baku production of oil during February from the various fields was 401,307 tons. Bailing yielded 31·6 per cent. of the gross production, compressors 24·9 per cent., deep well pumps 28·9 per cent., fountains 12 per cent., and 2·6 per cent. collected from other sources.

For the first five months of the current year the production exceeded by 2,133,512 tons that of the first five months of the preceding year, or 20·6 per cent.

The total amount of liquid fuel and gas used was 30,950 tons, or 7·5 per cent of the gross production.

The drilling for February was :—

	Metres.
Rod drilling	2295·0
Cable „	4075·6
Rotary „	9126·7
Total	1,5497·3

New Gasoline Installation.—The first attempt to produce gasoline by means of Prof. Tikvinsky's "locked cycle" was made in April, 1925, in Well No. 7638, 6th Plot, Surasenani. The first trial fully justified all expectations, viz. : (1) 200 kg. of gasoline daily, sp. gr. 0·740 ; (2) a surplus of gas up to 300,000 cub. ft. daily ; (3) an improved quality petroleum (in benzine contents).

On Bibi-Eibat 90 per cent. of the work of installing two of these cycles is completed, the delay being caused by non-delivery of necessary parts.

The equipment and installation of a gasoline works for producing 7 tons of benzine daily is now being carried out on the 2nd Plot, Ramani district.

Azneft's Vaseline Industry.—The production of vaseline was entered upon at the end of January, for medicinal and pharmaceutical purposes, and also to prepare grease for guns and rifles. Nobels Bros. vaseline works, erected in 1912, after a long stoppage has now been repaired and is now functioning. The raw material from which vaseline is extracted consists of parafine Surachani mazout, from which about 25 per cent. of solar oil is drawn off, the residue being a thick mass, difficult to mix, coloured black by the asphalt contained in crude petroleum, and which remains in the residue. This mass first of all undergoes purification by sulphuric acid to remove the majority of the asphalt and is then, in a liquid condition passed through a filter of fuller's earth and decolourising floridin. The result is first a white vaseline, then yellow, brown and finally black. The production of vaseline will be 400–500 poods monthly, afterwards reaching the pre-war production of 1000 poods.

Asphalt Works.—A newly-equipped works has just been started in White Town, for the preparation of asphalt, the first experiment giving good results ; it is of such good quality that it can be used in countries with warm climates. The daily output is 1000 poods, and it is projected to increase this to 3000 poods.

Wire Rope Factory.—The work in this factory is so satisfactory that besides Azneft, Grozneft and other undertakings are supplied with ropes. From 40,000 poods in 1923-24 and 50,000 poods in 1924-25, the production is now 10,000 poods of wire ropes monthly, and this is without increasing the number of workmen and without overtime work. The average output per working man has increased 70 per cent. in comparison with pre-war times.

T. W.

10. Grosny Oil and Gas Industry. General News. *The Azerbaidjan Oil Industry*. May, 1926. No. 5, p. 87.

The gross production of oil and gas consisted of 199,154·34 tons in April, as against 186,561·52 tons in March.

The drilling amounted to, by the rotary system, 1175·7 metres, and by the rod percussion system 4224·1 metres, a total for April of 5399·8 metres.

Emba.—The gross production for April was 19,395 tons, an increase of 528 tons over March. The drilling amounted to 369 metres.

Anapa Region.—White oil: In the Anapa district near to the village Suvorov-Tcherkas four oil plots are, by the most primitive means—horse gins and hand wells—producing a white oil containing up to 50 per cent. of benzine. Analysis has proved this benzine to be of a very high quality and suitable for aviation purposes. At present all oil produced is consumed locally at mills and factories, notwithstanding that it contains a residue of only 5·8 per cent. mazout, and when poured into lamps burns like clear paraffin.

The 22,000 poods of oil produced by the Anapa Trust during the half-year of its primitive work is a mere nothing when compared to the possibilities, which evidently the richness of this area permits, and measures should be taken to investigate, seriously and in detail, this oil-bearing section.

Dagestan.—The whole Eastern shore of the Caspian Sea presents an uninterrupted strip of oil-bearing beds. Pre-war all this land was bought up by the oil industrialists, but never developed. A commission of two geologists has now arrived at Makhateh-Kalu with a view to investigating the whole of the oil beds along the Eastern belt of the Caspian Sea. T. W.

11. Baku Oil Chronicle. General News. *The Azerbaidjan Oil Industry*. May, 1926. No. 5, p. 92.

The gross production for the Baku oilfields was, during April, 448,029 tons of petroleum and gas 13,486 tons.

The amount produced by deep well pumps equalled that produced by bailing, 1200 of the former being in exploitation during April, as compared with 1159 in March.

The total drilling completed during April was:—

	Metres
Rod system	3306·7
Cable „	3397·0
Rotary „	12,549·2
Total	19,252·9

Included in this total are 375·5 metres drilled while endeavouring to isolate and prevent water flooding.

The amount of drilling for April month is unprecedented for the Baku oil industry during the whole time of its existence.

New Gasoline Installations.—Azneft is at present erecting three factories to extract gasoline from gas—one each at Ramani, Surachani and Bibi-Eibat. The expected daily output for all three works is 700 poods gasoline. Those at Ramani and Surachani are nearly completed, and Bibi-Eibat will be working in August.

Besides these, separate cycle installations, according to Prof. Tikhvin's principle, are being erected in Surachani and Bibi-Eibat. There are already working eight installations, with an average daily production from each

erection of 20 poods light gasoline, which, being mixed with an average 100 per cent. ligroine, yields about 40 poods of export benzine.

T. W.

12. Utilisation of the Southern Part of Bibi-Eibat Bay. *The Azerbaidjan Oil Industry*. June-July, 1926. Nos. 6, 7, p. 8.

The author in a previous journal expressed his interest concerning (1) the possibility and adaptability of pumping the water out of the bay instead of filling it in, and (2) the idea of drilling on the water with the assistance of pontoons, its realisation in a technical and economical sense, and states that the work of filling in the Bibi-Eibat Kovsha Bay (24 desiatines in area) has been going on for six months.

On this territory, according to plans, it is possible to place 28 derricks with 50 sagénes between each.

It was decided not to carry out a compact filling in, but only to draw up a base-line for the situation of the wells and branches. This method of work would greatly decrease the cost as shown by the figures: (1) To form plots on the Kovsha on base-lines would cost Rbls.550,000, each derrick costing about Rbls.20,000; and (2) the compact filling in according to preliminary estimates, would amount to Rbls.700,000, or for each derrick Rbls.25,000.

There are four such base-lines projected. Their erection requires 48,000 cub. sag. earth, and for a compact filling in it would require 1,000,000 cub. sag. One such base-line is already completed; two will be finished, probably by the end of September. The fourth and largest, situated right opposite the Kovsha gate, will be made when the gate is finally closed: 50 sag. has already been filled in.

With a view to obtaining practical data concerning the pumping out of the water, instead of compactly filling in the southern part of the bay, or even the method of base-line work, an experiment was carried out in one part of the Kovsha. The experiment was fully successful.

The article states that an area of 3200 sq. sag. was experimented on. A centrifugal pump, 8 in. diam. piston, with a capacity of 12,000 vedros per hour was installed, and after five days' work discharged approximately 800,000 vedros of water, or 1000 cub. sag. of the basin's capacity, the water level dropping 1·5 m. During the first day's pumping the lowering of the water level was insignificant, evidently owing to percolation from the surrounding saturated territory, but during the following days the fall was noticeable. The suction valve becoming exposed, the pump was stopped and observation taken during four days as to the rise of the water level, which on the fourth day gave only 1 m. rise. It was discovered that the water penetrated from the sea through the newly-made breakwater in insignificant streams, and in these places slight landslips had occurred. The above statement shows that in observing the conformable technical conditions the pumping out of the water basins in the bay is possible, and that inundations of future plots in the emptied basins need not be feared.

This experiment has opened up a wide perspective, not only concerning the Kovsha, but the whole unfilled-in section to the south of Bibi-Eibat Bay, and a decision has been come to not to fill in the centre part of the Kovsha, along which it was proposed to carry the fourth base-line with an area of 12·5 desiatine, but to pump out the water.

The work will be carried out by blocking up the gate of the Kovsha with stones before the winter to avert the washing away of the embankment by the waves. Rubble will be added to the stones and backed up by a 3 sag. width of clay, followed by a sand filling in 20 sag. wide.

A double row of piles forming a diaphragm will be driven into the bed of the sea to the depth of 2 metres, with the intervening space filled in with puddled clay after the style of the Italian dams.

Such a method of operations will lead to a great economy. According to the estimate the compact filling in of the territory to Shikhov point (194 desiatines) would cost Rbls.4,892,000 and occupying four-and a-half years. The cost of pumping out the water, even with making an embankment 1 sag. high for roads and derricks on the former sea bed will be Rbls.1,900.000, or only 38 per cent. of the cost of a compact filling-in, and this work is expected to be completed in eighteen months.

At present preliminary work is being carried out to form the stone breakwater from Shikkov point to the end of the existing one. T. W.

13. The Oil Industry in U.S.S.R. General News. *The Azerbaidjan Oil Industry*. June-July, 1926. Nos. 6-7, p. 75.

Grosny.—The amount drilled during the third quarter, 1925-26, comprised the following :—

	April	May	June	Quarter.
Percussion system ..	4224·1 m.	4363·6 m.	5124·7 m.	13,712·4 m.
Rotary system ..	1175·7 m.	1794·9 m.	1245·9 m.	4216·2 m.
Total	5399·8 m.	6158·5 m.	6370·6 m.	17,928·6 m.

The production of oil for the same period was 665,817·74 tons, including gas.

Emba (New District).—The first deep well has been put down at Sakiz, which is one of many places in the Ural Emba district with signs of oil. The well is situated 20 versts to the south-east of Dosser. At a slightly lesser depth than surmised oil sand was met. Owing to this, and taking advantage of suitable clay, a cementation is being made at the above-mentioned place.

Anapa District.—Investigations carried out in the Anapa and Temruk districts of the Taman peninsular have established that, geologically, the peninsular has a perfect similarity with the Surachani oil-beds at Baku. Taman oil, from a depth of 3-4 arschins, has a S.G. 0·810-0,840 which give it the right to be called a high quality oil.

Especially good oil was obtained from wells in Staro-Titorov. Several veins of light green oil were found which are rich in benzine. These wells are not in exploitation, being of a prospecting character. At a depth of 60 sag. the well came in a fountain with oil S.G. 0·720. The system of working is very primitive and an extremely limited production—150-200 poods daily is obtained. It is proposed to increase this to 100,000 poods this year. T. W.

14. The Azerbaidjan Oil Industry. General News. *The Azerbaidjan Oil Industry*. *June-July*, 1926. Nos. 6-7. p. 84.

Baku.—During May, 1926, the total production on the Baku oilfields was :—473,885·5 tons of oil and 13,059·7 tons of gas.

Fuel expended amounted to 23,039 tons, or 4·9 per cent. of the gross production.

The drilling was :—

	Metres.
For exploitation	16,191·0
„ prospecting	2,247·7
„ economy	443·9
„ insulation	60·5
Total	18,943·1

According to the system of drilling this gives by :—

	Metres.
Rod drilling	2,451·8
Cable „	3,639·7
Rotary „	12,851·6
Total	18,943·1

The production of oil and gas for June was a total of 495,970 tons. Fountain oil amounted to 77,874·5 tons of the total output or 16·1 per cent. Fuel used was :—Oil, 11,923·6 tons : gas, 8,559·0 tons ; total, 20,482·6 tons or 4·1 per cent. of the gross production, this percentage is decreasing from month to month.

The following was drilled during June :—

	Metres.		Metres.
Exploitation ..	18,810·4	By Rod ..	2,682·1
Prospecting ..	1,332·9	By Cable ..	3,392·7
Economy ..	503·8	By Rotary ..	14,572·3
Total ..	20,647·1	Total ..	20,647·1

T. W.

15. GROSNY. GENERAL NEWS. *The Azerbaidjan Oil Industry.* Aug.-Sept., 1926. No. 8-9, p. 93.

The gross production of oil and gas on the Grosny oilfields during July was 232,257·67 tons, a decrease of 2,708·5 tons compared with June. Fountain oil amounted to 142,065·7 tons while gas was 5,786·8 tons.

With the exception of 16,975·8 tons collected from ponds, the production is classified as follows :—

	Tons.
Paraffin oil	124,087·5
Slightly paraffin oil ..	47,239·4
Non-paraffin oil	33,168·1
Total tons	209,495·0

The fuel used amounted to 17,856·8 tons or 7·6 per cent. of the gross production.

The amount drilled during July, reached 7,699·2 metres, of which 2,129·8 metres were completed by the Rotary system and 5,569·4 metres by percussion drilling.

The drilling during August consisted of 5,658·4 metres, by the percussion system and 1,771·6 metres by rotary, a total of 7,430·0 metres.

The production of oil and gas, during August, reached 231,819·28 tons ; Fountain oil being 147,438·80 tons and gas 5,703·35 tons, 6,875·19 tons was collected from lakes.

Fuel consumed during August reached 17,883·38 tons, or 7·7 per cent. of the gross production.

The Aldin Water Conduit.—On August 21st, Grosneft took over, after a preliminary two weeks' trial, from the "Vodocanal Co," a 25 in. self-gravitating conduit, 6 km. long, supplying water from the Aldin springs (river De-Shewda) to the central pumping station, situated in the Works District. From there it will be delivered on to both the old and new areas. The temperature of this water, even on hot days, is only about 14° C.

The Kuban-Black Sea District of Grosneft.—Grosneft has accepted the following programme for 1926-27 operating year for the Kuban-Black Sea district.

Production.	Light Oil.	Heavy Oil.	Total.
Maikop District ..	57,264 ..	17,048 ..	74,312
Kaluga „ ..	— ..	13,319 ..	13,319
Total tons ..	57,264 ..	30,367 ..	87,631

On the Maikop district 10 wells (9 for light oil and 1 for heavy oil) are to be drilled, with 1 for heavy oil in the Kaluga district.

The drilling programme is estimated at :—

	Metres.
For the Maikop area	6,082
For the Kaluga area	384
Prospecting, Maikop area only	2,134
Total ..	8,600

The Future of Kuban Oil.—The amalgamation of Kubcherneft with Grosneft was officially formulated as from April 1st, 1925, and the following 5 years programme has been adopted :—

	Production.	Drilling. Exploitation. Wells.	Prospecting. Wells.
1925-26 ..	6,000,000 ..	15 ..	—
1926-27 ..	11,000,000 ..	44 ..	10
1927-28 ..	15,000,000 ..	60 ..	9
1928-29 ..	22,000,000 ..	64 ..	7
1929-30 ..	40,000,000 ..	77 ..	7

The Kuban oil deposits have not yet been investigated, and only this year a geological expedition has been organised to carry out a detailed investigation of that strip of oil land beginning with Ilsky and Kaluga, through Khadijensky to Shirvansky. This survey should put an end to "wild catting" and establish connections between districts and give an accurate idea of the potentiality of the oil deposit.

Emba.—In July, the Dossor and Makate oil fields produced 17,463 tons, a decrease of 6·5 per cent. compared with June output. This was due to the wells exploited by means of compressors (from 1589 to 1077) and to fewer fountains (from 438 to 280). The production of deep well pumps remained practically the same (15,778 and 15,551).

The drilling has also decreased in July—522 metres against 661 metres in June.

Oil was unexpectedly discovered at a depth of 85 metres in well No. 200, VII section, Dossor, after making a water shut-off above the first horizon. The well yielded 6 tons on the first day and 10 tons on the second. The latest information gives the production at 60 tons daily. T. W.

16. The Baku Oil Chronicle. General News. *The Azerbaidjan Oil Industry.* Aug.-Sept., 1926. No. 8-9, p. 102.

July, 1926, is significant in the life of the nationalised Azerbaidjan oil industry, that the average daily production, during this month, exceeded 1,000,000 poods.

The total production of oil and gas for July was 522,405 tons.

Fuel expended amounted to—oil 9589·7 tons and gas 9009·2 tons, a total of 18,598·9 tons, or 3·6 per cent. of the gross production.

Drilling during July was as follows:—

	Metres.
Rod drilling	2456·0
Cable „	3930·8
Rotary „	12,333·5
Total	18,720·3

—which was 2502·6 metres less than in June.

The total production of oil and gas during August was 547,215 tons. August was noticeable for its production of fountain oil, which amounted to 100,531·9 tons, or 18·9 per cent. of the gross production. Such a percentage of fountain oil is an exclusive and rare occurrence for the Baku district.

Fuel used during August was—oil 8384·2 tons, gas 9183·2 tons, a total of 17,767·4 tons, 3·2 per cent. of the gross production.

Drilling during August amounted to:

	Metres.
Rotary drilling	14,270·2
Cable „	4146·4
Rod „	2309·4
Total	20,760·0

Prospecting in the Baku District.—Prof. I. M. Gubkin having been instructed by the Supreme Council of Oil Economy to investigate the prospecting work of the Oil Trusts, has given to the Press some interesting data of a general character.

A geological survey is being made in the Baku oil-bearing districts, remote from the contemporary Baku areas, at Khankishliak and Kabristan.

Khankishliak is situated 45 versts from Salian and has long been known as abounding in oil seepages. In 1915–16 a well was drilled 360 sag. deep, but without showing any results.

In 1916 some shallow wells 10–15 sag. deep were drilled. Some of these produced fountain oil, one well is still overflowing; local lessees are exploiting the others.

Two prospecting bore holes are being drilled; one is already 37 sag. deep, through dark grey clay with veins of sand.

Kabristan, like Khankishliak, has also long been known as having signs of oil. This area lies to the south of the river Sumgait, is bounded on the east by the Caspian Sea and on the west by the meridian of Shemakha. Geological surveys of several separate sections of this district are being made in the neighbourhood of the mountain Toyraghai, 18–20 versts west of the station Sangachal. A survey is also being made in the neighbourhood of the mountain Chyil-dag, where some oil seams have been opened up, besides the formerly known oil layers.

In the ensuing year Azneft proposes to explore the Adjekabul region, the most interesting district being that of Akhtarma-Pashali, situated 15 versts to north-west of the station Adjekabul. Detailed geological investigations are being carried out at Karadag and Puta.

Ramani Tunnel.—This tunnel was constructed in 1902–03 to drain the waters of Sabuntchi, Ramani and partly Balachani into the sea, its length

being 2814 m., width 1·60 m. and height 2·13 m. The walls and arched roof are brick, the floor of local stone. It is 14 to 55 m. below the surface and has 10 shafts for service. More than 3–4 million vedros of water are drained away daily. Pre-war the tunnel was cleaned out in 1913. Until 1921 it became gradually fouled, when an unsuccessful attempt was made to clear it.

At the end of 1924 the depth of the deposit in the tunnel reached 1·17–1·50 m. The water rose 1·50 m. above the arch, saturating the surrounding ground and the probability of its demolishment was foreseen. The waters in Ramani lake rose 3 m. above normal, flooding the road and part of the first industrial section.

The work of cleaning the tunnel began in the spring of 1924, and was carried on by means of round and square shields, which were dragged along the bottom of the tunnel, from shaft to shaft, by steel hawsers; 926 shields of different shape and size were used and 7350 cub. m. of mud were removed. Four thousand two hundred and twelve working days were spent on the work. The water in Ramani lake has dropped to normal.

Investigation of the Baku-Batoum Pipe Line.—The question has lately arisen of improving the colour of exported kerosine delivered to Batoum from Baku. As a result of a whole series of measures carried out at the refineries in Baku, the colour of the kerosine was considerably improved; yet, notwithstanding a large outlay by Azneft and the higher production cost of the improved kerosine, the fundamental object of these measures could not be attained as the colouring became worse while in transit to Batoum. Therefore the examination of the Baku-Batoum pipe line was undertaken, the following results being obtained:—

(1) In the Baku-Kinrok-Chia the 8-in. pipe line lies upon the surface of the ground and is painted with tar, owing to which the kerosine is heated up to 45° C. in May and June. The heated kerosine upon entering the reservoir comes into contact with the atmosphere and is subjected to oxidation, which tends to discolour the kerosine.

(2) The kerosine drippings from the pump glands, piston and flanges, made dirty by the lubricating oil drippings, is systematically mixed with the export kerosine while being pumped, and naturally makes the colour worse. At each station this refuse amounts to about 200 poods daily, which, at the 10 operating stations, amounts to about 4 per cent. of all the export kerosine pumped through the line.

(3) The number of operating relief stations, at the present rate of pumping, must be considered excessive, as it lengthens the time in which the kerosine remains in the intermediate reservoirs.

(4) The reservoirs, especially on the western section of the pipe line, are not cleaned sufficiently, and many of them are therefore dirty with rust, mineral and organic matter.

The following measures are to be carried out in order to prevent oxidation and contamination:—(*a*) To bury the pipe line in the ground from Baku to Kiurok-Chia, properly insulated to prevent deterioration in the salt marsh ground; (*b*) to discard entirely the mixing of the export kerosine with the contaminated oil, to collect the drippings and leakages, separate reservoirs should be portioned off at each operating station; (*c*) to clear and wash out all storage for export kerosine and in future to do this systematically; (*d*) To curtail to the possible minimum the number of intermediate stations in accordance with the intensiveness of pumping.

When these measures are enforced it is expected that the discolouration of the kerosine will not be excessive. T. W.

17. The Oil Industry in U.S.S.R. General News. *The Azerbaidjan Oil Industry*. Oct., 1926. No. 10, p. 62.

Grosny.—The production on the Grosny oilfields for September was 226,000 tons of oil—August 225,000 tons. Fountains produced 155,000 tons, pumps 43,000 tons and bailing 26,000 tons.

There were 405 wells in exploitation. The drilling amounted to 7,710 metres.

1926–27 *Programme.*—Grosny during 1925–26 produced 2,458,000 tons of oil and gas. The estimated production for 1926–27 is 2,476,700 tons oil and gas, an increase of 0·76 per cent. only. This insignificant increase is explained by Grosny production being founded on fountains, the forcing of which, owing to other oil areas not being ready, might lead to a break on the old oilfield area, already sufficiently exhausted.

The drilling is estimated at 67,700 metres for exploitation, and 25,000 metres for exploratory work—total 92,700 metres. Of this amount 36,800 metres will be drilled by the rotary system, and 55,900 metres by the percussion system.

Emba.—The total production on the Emba oilfields, during September, reached 20,503 tons—2,445 tons more than August. The largest amount, 16,186 tons was produced by deep well pumps, followed by compressors with 2,753 tons, fountain oil being 595 tons.

365 metres were drilled, prospect drilling consisting of 179 metres.

1926–27 *Programme.*—The production of oil has been estimated at 247,500 tons, of which 204,000 tons are expected from Dossor and 43,500 tons from Makat. Besides oil Dossor should produce 1,630 tons of gas.

Both Embaneft refineries will, in the ensuing year, have an output of 27,700 tons of kerosine, 12,700 tons lubricating light oils, 8,200 tons dark oil, 12,800 tons special oils, 17,400 tons various greases, 94,800 tons motor fuel.

The programme of deep oil prospecting drilling, in the Ural-Emba region, during the ensuing year is foreseen at 6,400 metres for 32 wells. T. W.

18. The Baku Oil Chronicle. General News. *The Azerbaidjan Oil Industry*. Oct., 1926. No. 10, p. 65.

Azneft's Programme 1926–27.—*Production.*—Azneft estimates its production for the year 1926–27 at 6,242,000 tons (381 million poods) of oil and 181,800 tons (11 million poods) of gas, in the equivalent of oil, a total of 392 million poods. This production will be obtained from: (1) old wells, (2) restored wells (abandoned), (3) new wells, (4) repaired wells and also from shafts and traps.

Concerning the method of exploiting wells it is proposed to continue the existing rational organisation—to extend the closed in system of exploitation by developing the installation of deep well pumps and to curtail the extraction of oil by bailing.

The following is the estimated production by category of wells:—

	No. of Wells. 1/10/26	30/9/27	Production. Tons.
(1) Old Wells ..	2,695 ..	2,454 ..	4,787,082
(2) Restored Wells	— ..	240 ..	46,004
(3) New Wells ..	— ..	385	1,303,945
(4) Repaired Wells	— ..	79 ..	50,238
Shafts and Ponds ..	— ..	— ..	51,580
Total Tons			6,241,849

The fuel expenditure is estimated at 193,702 tons for the year.

The programme forsees the absolute and relative decrease of fuel used, a larger consumption of gas instead of oil, and a diminished expenditure of fuel for steam raising.

Drilling.—Azneft estimates the drilling for 1926–27 at 237,870 metres (111,609 sag.) as follows :—

	Metres.
Rotary drilling	150,549
Turbine „	7,697
Cable „	64,900
Rod „	14,724
	237,870

Exploratory Drilling.—Exploratory drilling is divided into two categories :—

	Metres.
Old areas	19,980
New areas	11,114
Total	31,094

Drilling on old areas will be to new horizons.

The second category are those new areas where work will be carried out to prepare new grounds. Of the total of 11,140 metres, 9,148 metres will be drilled on the Apsheron peninsular territory.

Liquidating Wells.—This problem, of isolating water logged wells remains about the same for 1926–27 as for the preceding year and is carried out only by rod drilling. T. W.

19. The Azerbaidjan Oil Industry. General News. *The Azerbaidjan Oil Industry.* Oct., 1926. No. 10, p. 73.

The Baku production for September was 505,604 tons.

Of the total amount of oil product 136,835·7 tons was heavy oil and 356,083 tons light oil.

Fuel used was 8,342·5 tons of oil and 8,703·8 tons of gas, a total of 17,046·3 tons or 3·4 per cent. of the gross production.

Drilling during September amounted to :—

	Metres.
Rotary	12,252·5
Cable	4,257·4
Rod	1,773·9
Total	18,283·8

The following gives a comparison of drilling since nationalisation in sagenes :—

	Sag.
1920–21	1,608
1921–22	7,068
1922–23	23,661
1923–24	36,599
1924–25	57,191
1925–26	95,143

It should be noted that the monthly drilling average, about 9,500 sag., during the latter months, greatly exceeds the pre-War rate. The total drilled, 95,143 sag., is also the maximum yearly rate during the whole time of existence of the Baku oilfields, the nearest being in 1899 with 85,869 sag.

Azneft's New Works.—Two gasoline works have been erected—one at Surachani and the other at Bibi-Eibat. Both are working with a full load. All necessary parts, material and equipment were made locally, and upon testing proved to be no worse than foreign. The works—the only ones in the U.S.S.R. were built and equipped according to the last word of American technology.

Bibi-Eibat gasoline works is calculated on a capacity of 5 million cub. ft. of gas. The production of the other works is more than double. Both works have shown they can work with a double load. During the first days it was clearly seen that the cost of construction would be redeemed in a few months. In the event of the benzine production increasing, the gasoline works can enlarge their production to 20 million cub. ft. of gas without capital reconstruction and with the minimum expenditure.

The Surachani works, built for refining benzine by means of coal commenced working in the middle of August.

New Kerosine Refinery.—A new kerosine refinery, on the American style of tubular stills is under erection in Baku mainly to distill Bibi-Eibat oil. The works will consist of two parallel installations of four tubular stills with a daily capacity of 80,000 poods of oil, yielding 8,000 poods of finished benzine and 24,000 poods of kerosine.

To purify the kerosine it is proposed to make use of one of the neighbouring kerosine refineries of the old works. In case of necessity this works can put through up to 160,000 poods of oil, distilling it into benzine and not extracting all the kerosine. T. W.

Chemistry of Petroleum.

20. The Synthesis of Petroleum. F. Fischer. *Fuel*, 1927, **6**, 89–94.

Petroleum-like products may be produced by the distillation, with or without pressure, of coal, peat, oil-shale, fats and waxes or by the hydrogenation of coal under high pressure.

Hydrogenising syntheses build up large from small molecules. Thus Berthelot in 1866 obtained benzol and tar-like hydrocarbons by heating acetylene at atmospheric pressure; Sabatier (1897) converted ethylene by heating in presence of a nickel catalyst above 300° C. into a mixture of gaseous and liquid hydrocarbons; Sabatier (1899) reduced acetylene by means of nickel at atmospheric pressure and obtained saturated gaseous and liquid hydrocarbons; and in 1906, Ipatieu polymerised ethylene under pressure at 400° to 500° C. into partially liquid hydrocarbons of the formula C_nH_{2n}.

Hydrogenation of carbon monoxide with the latter in excess, according to G.P. 293,787, 1913, *i.e.*, using different catalysts and temperatures and pressures of 400° and 120 atmospheres respectively, gave oily and watery products, the former chiefly consisting of hydrocarbons.

Hydrogenation of carbon monoxide with hydrogen in excess, however, according to the method of Tropsch and Fischer, *i.e.*, using high pressures and alkalised iron as contact material, gave results differing from those of G.P. 293,787. Oily and watery layers were obtained, but the former (Synthol) consisted, not of hydrocarbons, but almost exclusively of higher alcohols, ketones and aldehydes, with some higher fatty acids. The stronger

the basicity of the alkalised iron, the larger—up to 9 atoms of carbon—were the molecules produced.

Using zinc oxide and avoiding strong bases and metals of the iron group, the hydrogenation of carbon monoxide at 400° C. and at pressures exceeding 130 atmos. stops at methyl alcohol (Patart's process). Using hydrogen and carbon monoxide in the theoretical proportions, very pure methanol results.

In all catalytic processes the reactants require to be purified from catalyst poisons, but the product is generally in a high state of purity.

Finally, if a mixture of chemically pure hydrogen and carbon monoxide, or water gas, generator gas or blast furnace gas purified by Fischer and Tropsch's method are passed over finely divided iron or cobalt at 200° to 300° C. and at atmospheric pressure, gaseous, liquid and solid hydrocarbons result. About a 50 per cent. yield can be attained by a single passage over a good catalyst. It is relatively easy to suppress the formation of methane, difficult to produce higher homologues, *e.g.*, gasoline instead of "gasol" (a mixture of ethane, propane and butane), but simpler to obtain the solid paraffins. The contact materials behave differently and unknown factors operate. With regard to yields, more than 100 g. of solid, liquid and easily liquefiable hydrocarbons can be obtained per cub. m. of water gas provided the gas be conducted several times over the catalyst. H. G. S.

21. Diethyl Sulphate in the Examination of Hydrocarbon Oils.

J. N. Taylor. *Ind. Eng. Chem.*, Jan., 1927.

Dimethyl sulphate has been used to differentiate between paraffinoid and naphthenic and unsaturated and aromatic hydrocarbons. In this paper the use of diethyl sulphate is attempted, as the toxic effects of the lower homologues make its use objectionable.

The first series of experiments described gives the results of sulphonation and use of both dimethyl and diethyl sulphates on synthetic mixtures of benzol and paraffin hydrocarbons from petroleum distillates. Thus it is shown that the original procedure in the use of dimethyl sulphate requires slight modification for the higher homologue, and this is effected by the addition of a known quantity of inert paraffinoid substance to the reaction mixture.

There follows a table containing the results obtained by sulphonation and diethyl sulphate treatment on various commercial products, and in no case do the results vary by more than 4 per cent. A. R. S.

22. The Composition of Gasoline as Indicated by Close Fractionation. J. B. Hill, L. M. Henderson, and S. W. Ferris. *Ind. Eng. Chem.*, Jan., 1927.

Four gasolines of known history and origin were fractionated by means of a 5-ft. Snyder column with a controlled reflux. Fractions consisting of 2·5 per cent. of the total charge were collected and the sp. gr., critical solution temperature in aniline, refractive index and A.S.T.M. distillation of each were determined. Thus graphs were plotted of the boiling-point at 50 per cent. distillate against sp. gr., refractive index and aniline point.

The curves so obtained show a surprising regularity of peaks and troughs for any one gasoline, while in all four the curves show peaks and troughs in approximately the same places.

A comparison of these curves with corresponding ones for pure paraffins, olefines, naphthenes and aromatics, seems to indicate a high concentration of naphthenes at the peaks, while the troughs show a corresponding high concentration of paraffins.

The similarity of curves in all four shews that the same components are present in each case, differing only in amount, while a comparison of the troughs with the curves for pure paraffins seems to support the view that most of the paraffins present are straight chained.

Much closer fractionation of one of the gasolines gave much higher peaks and correspondingly depressed troughs, as was to be expected.

While the results of this work are of considerable speculative interest, the authors do not consider them as warranting conclusions. A. R. S.

See also Abstracts Nos. 39, 41, 45, and 46.

Natural Gas.

23. Apparatus for Extraction of Gasoline. C. H. Brown. U.S.P. 1,607,402, Nov. 23rd, 1926.

A method is described for extracting spirit from gases from wells. The gases are passed into an absorber meeting a fine spray of oil which has been stripped of its spirit. The oil absorbs the heavier spirit, which is then distilled off in a steam-heated still.

The remaining gases pass on to a second absorber and the spirit is afterwards removed by a distillation in vacuo, the heat being supplied by steam coils if necessary.

Appropriate condensing systems are fitted to both stills. K. B. R.

See also Abstract No. 88.

Motor Spirit.

24. Utilisation of Methyl Alcohol as a Possible Automobile Fuel. Paul Dumanois. *Oil and Gas J.*, Dec. 2nd, 1926.

The synthetic production of methyl alcohol has led to investigations into the possibility of using it as a motor fuel.

Two objections to this substance are its low calorific power and the possibility of the production of corrosive products by incomplete combustion.

Tests carried out with a fuel containing 70 per cent. methyl alcohol in a standard 10 h.-p. Citroen car showed that although fuel consumption was higher than with petrol, better performance of the engine was obtained.

K. B. R.

25. Modern Motor Fuels. W. A. Whatmough. *Automobile Engineer*, Jan., 1927.

The physical constants, particularly those affecting ease of starting, of the following No. 1 petrols are given: Shell, Pratt's, Red Line, British Petroleum, National Benzol mixture and Russian Oil Products, all except the last mentioned compare very favourably with American gasoline. A considerable increase is noted in volatility of 1926 spirit over 1922 spirit as regards the first 30 per cent. of the Engler distillation. Pratt's No. 1 is found to contain 10 per cent. extra of light spirit in 1926 as compared with 1922; Redline No. 1 contains the lowest free sulphur and is the least gumming according to the colour of the Engler residue. Shell No. 1 has changed from one of the heaviest spirits in 1922 to one of the lightest in 1926. Russian Oil Products petrol in 1926 corresponds closely with Taxibus No. 3 petrol in 1922 in volatility. National Benzole mixture has in 1926 a volatility corresponding to a No. 1 petrol. The petrols are ranged in the following order of merit as regards ease of starting, from the examination of Engler distillation curves: Shell No. 1, Redline, Pratt's, B.P., Russian Oil Products.

W. N. H.

26. Changes in Gasoline Specifications. C. O. Willson. *Oil and Gas J.*, 1926, xxv. (30), 42, 150.

The most important change in gasoline specifications during 1926 has been in distillation range. In previous years, the bulk of Mid-Continent gasoline had a gravity under 50° B. and an F.B.P. of 450° F. The remainder met the U.S. motor gasoline requirements of I.B.P., 131° F.; 20 per cent., 221° F.; 50 per cent., 282° F.; 90 per cent., 392° F.; F.B.P., 437° F.

Distillation tests of twelve samples of gasoline sold in Tulsa at 21 cents showed that six had a gravity of over 60° B. and only one under 58° B. All had an I.B.P. of under 131° F., ranging from 106° to 124° F. At the 20 per cent. point, all were under 221° F., the lowest being 180° and the highest 212°; at 50 per cent., there were above 282° F., the range being from 240° to 294°; at 90 per cent., four are over the Government maximum of 392° F., ranging from 330° to 404° F. F.B.P. ranged between 390° to 450°, eight samples coming below the 437° F. limit.

Three samples of premier gasoline, retailing at 24 and 26 cents, were tested and gave, respectively: gravity, 62·6°, 63·8° and 59·8° B.; I.B.P., 106°, 114° and 122° F.; 20 per cent., 166°, 168° and 200° F.; 50 per cent., 234°, 222° and 260° F.; 90 per cent., 364°, 312° and 360° F.; the F.B.P being 416°, 390° and 424°.

One sample, having a retail price of 19 cents, had a gravity of 62·9° B., I.B.P., 94° F.; 20 per cent., 162° F.; 50 per cent., 300° F.; 90 per cent., 436° F.; and F.B.P., 456° F. G. S.

27. Process of Treating Liquids. Lyle Caldwell. U.S.P. 1,603,314, Oct. 19th, 1926.

A method is described for refining petroleum products and vegetable and animal oils by using silica in the form of powdered sand, quartz or Kieselguhr—in combination with lime.

After acid treatment the gasoline or oil is treated with this treating agent.

The author claims that this agent purifies gasoline containing as much as 4 per cent. sulphur and also removes the gummy substances found in cracked spirits. K. B. R.

28. Improvements in and Relating to Fuels for Use in Internal-combustion Engines and for other Purposes. E. G. E. Meyer. E.P. 262,363, Dec. 13th, 1926.

The improvement consists in adding ether to a high boiling petroleum fraction, with or without the addition of a small percentage of a low boiling fraction, the ether being retained in solution by the addition of ammonia. S. W. C.

See also Abstracts Nos. 3, 22, 23, 40, 50, 79, 80, 81, 87, and 98.

Lubricating Oil and Wax.

29. Oil Rectification. The Continuous Renovation of Lubricating Oils. *The Automobile Engineer*, vol. XVI., No. 223, Dec., 1926.

Lubricating oil used in internal-combustion engines develops a sludge which in course of time acquires abrasive properties.

Filtration of used oil through a Hele-Shaw streamline filter has been found to produce an oil which is superior to the original fresh oil.

Filters which may be fitted to internal-combustion engines are described. They are of the pressure type in which the oil is forced from the outside

to the centre of the filter; the sludge remaining as a cake on the outside of the filter, from which it can be removed by blowing with an ordinary tyre pump.

Small or large units are made according to the size of engine for which the filter is required. K. B. R.

30. Changes in Properties of Four Unblended Mineral Oils Produced by Prolonged Treatment with Ozone. M. V. Dover and J. H. Cromwell. *Ind. and Eng. Chem.* Vol. No. 1, 94.

Four unblended mineral oils (two from paraffin-base and two from asphaltic-base crudes) were subjected to a stream of ozone for 8 hrs. at laboratory temperature for 16 hrs. at 27° C.

The object of the work was to find out whether there was any relation between any physical or chemical property of an oil and its lubricating power measured as the coefficient of static friction by means of a Deeley machine.

The following constants of the oils were found before treatment after 8 hours at laboratory temperatures and after 16 hours at 27° C.: Specific gravity, surface tension, interfacial tension (oil-water), viscosity, acid number, iodine value refractive index and coefficient of static friction.

The ozone was supplied from a laboratory ozoniser, but no attempt was made to measure the quantity passed into each oil.

Work is still proceeding on the subject, but as far as the above constants are concerned no analogy between any constant and the lubricating power of an oil could be found.

Some anomolous results were obtained which are interesting, *e.g.*, whereas with three oils the viscosity rises after each successive treatment of ozone, one oil gives the following viscosities: untreated 435 after 8 hours ozone, 659 after 16 hours ozone 537. K. B. R.

31. The Corrosion of Steel by Lubricating Oils containing Small Amounts of Moisture and Alkalis. W. Singleton. *The Industrial Chemist*, Dec., 1926.

This paper gives results of investigations on the action of lubricating oils on steel; the work was carried out in order to obtain data on the deterioration of lubricating oils and the subsequent corrosion of the steel in steam turbines.

Strips of steel were immersed in four different oils for lengthy periods (400—1000 hours) at 80° C. A series of experiments were carried out: (*a*) with the oils perfectly dry, (*b*) with the oils containing 0·2—1 per cent. of distilled water, (*c*) with the oils containing 0·2—1 per cent. of alkali salt solutions. Microphotographs were taken of the steel before and after immersion in the oils.

It was found that in case (*a*) practically no corrosion had taken place with the two neutral oils, but in the case of the other two oils, which had been used previously and contained about 1 per cent. organic acids, noticeable corrosion had taken place.

In case (*b*) more corrosion was noticed in all cases, but that with the neutral oils was greater than that obtained with oils containing organic acids.

In case (*c*) still more corrosion took place, and here once more the oils containing organic acidity showed less corrosive action than the other two oils.

Thus it seems that in the absence of moisture organic acidity promotes corrosion, but where moisture or alkali salt solutions are present corrosion is retarded by organic acidity.

In conclusion the author has shown that small amounts of the fatty acids have no appreciably corrosive action on steel, thus it is only organic acidity which is developed by oxidation of the oil which has the above mentioned effects on steel. K. B. R.

32. Recent Researches on Friction and Lubrication. J. E. Southcombe, *The Automobile Engineer*, Dec., 1926.

Of the two kinds of friction recognised, namely, fluid and boundary, the former varies as the viscosity of the lubricant, the relative velocities of the surfaces and the area of the surfaces, whereas the latter varies as the load. *i.e.*, the pressure, on the surfaces.

In cases where zero velocities occur, fluid friction cannot exist; thus in such cases boundary friction comes into consideration. It was long known that viscosity of lubricants was not the only factor which influenced the friction and the term "oiliness" was coined. It was also known that the glycerides of fatty acids possessed "oiliness" in a higher degree than mineral oils.

In 1920 Wells and the author showed that the addition of small amounts of fatty acids to mineral oils increased their efficiency as lubricants. This has been confirmed by subsequent experiments with the Daimler Lanchester worm-gear testing engine and the Stanton pendulum.

Langmuir and other workers have shown that when a fatty acid spreads on the surface of water the film so formed is mono-molecular, the acid molecules being orientated in such a way that they are attached to the water surface by their carboxyl groups, the remainder of the carbon chain being in a plane at right angles to the water surface. Woog has shown that the lubricating efficiency of a number of oils varies as the molecular volume. Work is in progress which tends to show that oil films on metallic surfaces are not monomolecular.

Figures are given which illustrate the efficiency of the "Germ Process" oils for machinery where boundary effects come into play. K. B. R.

33. Improvements in or Relating to the De-acidification of Oils and Fats. Hermann Bollman. E.P. 258,788. Sept. 30th, 1926.

In order to avoid the formation of emulsions when oils are treated with caustic soda, the author recommends that a 10 per cent. solution of soda be ground in a colloid mill with a heavy substance such as talc or powdered marble or with a metal powder, *e.g.*, powdered aluminium.

The intimate mixture of the alkali and the carrier neutralise the fatty acids in the oil and carry the soap so formed with them to the bottom of the container. Separation may be effected in a filter press. K. B. R.

34. Process for the Purification of Mineral Oil Distillates and of Paraffin Wax. Burmah Oil Co. and R. R. le G. Worsley. E.P. 260,455, Jan. 27th, 1926.

Any fraction of a petroleum, shale or coal oil, etc., or wax, is refined by subjecting it to the action of fuller's earth or other hydrosilicate while in vapour and at a reduced pressure. The temperature maintained is not more than is sufficient to maintain the oil in vapour, and the vacuum is as high as practicable, particularly in the case of treatment of the higher-boiling fractions. The vapours may be purified by contact with increasingly active adsorbent in successive chambers, and may be preliminarily washed with sulphuric acid, or with alkali, to remove phenols, and with water. These processes may alternate with the treatment with adsorbent. Inert

gases may be passed through the adsorbent with the oil vapours to reduce the time of operation. The process is adapted to the production of petrol and kerosene fractions. H. M.

35. Improvements in or Relating to Purification Systems for the Lubricating Oil of Internal-combustion Engines. The Sharples Specialty Company. E.P. 231,877, Oct. 4th, 1926.

This patent describes a centrifugal separator, which may be connected to internal-combustion engines for removing solid and volatile impurities from the lubricating oil used in such engines.

It consists of a rotating bowl encased in an outer jacket. The contaminated oil is pumped into the rotating bowl; the clarified oil is ejected over the rim of the bowl in the form of a spray meeting a blast of hot or cold air which removes the last traces of water vapour and low boiling hydrocarbons. The purified oil is then returned to the reservoir.

The bowl is easily removed for cleaning purposes. A full description of the driving power for the rotating bowl is given. K. B. R.

See also Abstracts Nos. 2, 42, 43, and 48.

Special Products.

36. An Improved Manufacture of Petroleum and Petroleum Oils. E.P. 259,442, Oct. 14th, 1926.

In this patent directions are given for preparing water-white liquid paraffin which is odourless and does not deteriorate on standing.

In the method used, the oil is mixed in equal proportions with oil which has already been treated. The whole mass is then treated with two-thirds of its own weight of 20 per cent. oleum. After agitation at an elevated temperature the oil is drawn off the carbonaceous residue. The residue is treated with a suitable solvent and after distilling the solvent the extracted oil is added to the main bulk and the whole neutralised and filtered through decolorising clay.

An alternative method may be adopted in which the use of treated oil is dispensed with. In this case the crude oil is treated with oleum at 100° C. The temperature is then slowly raised to about 180° C. The oil is then given a second acid treatment to remove all the sulphonated compounds by carbonisation. Neutralisation and filtration follow as before. K. B. R.

37. Improved Manufacture of Asphalt or like Substances in Finely Divided Condition. Dr. Franz Rudolf Moser, assr. to De Bataafsche Petroleum Maatschappij. E.P. 245,418, Dec. 2nd, 1926.

Asphalt is first emulsified and then the emulsion allowed to coagulate in the presence of added colloid particles. Thus the asphalt gel is obtained in the form of a fine mud which resists further coagulation. A. R. S.

38. Art of Preparing Pitches. F. M. Rogers and O.E. Bransky, assrs. to Standard Oil Co. U.S.P. 1,613,723, Jan. 11th, 1927.

The method is claimed of producing a binder or briquetting pitch, by introducing acid coke into hydrocarbon oil of high viscosity at a temperature of 212° F., and subsequently reducing the mass by heating in presence of steam at a temperature not exceeding 600° F., until the desired softening point is reached. A. R. S.

See also Abstract No. 76.

Analysis and Testing.

39. DETERMINING SMALL MOISTURE CONTENT IN MINERAL OILS. Translated from W. Boller's paper, *Chemicker Zeitung*, 1926, 437. *The Refiner*, Dec., 1926.

The usual method of estimating the water content of oils by dissolving the oil in xylol and distilling the water over with the xylol is not accurate for small percentages of water owing to the error introduced by the solubility of water in xylol.

The following method makes use of the action of water on calcium carbide.

The apparatus consists essentially of a long tube containing calcium carbide which has been freed from acetylene by heating to 260° C. in a current of hydrogen or nitrogen for some time. The procedure adopted is as follows: Dry hydrogen is bubbled through the oil at a temperature of 130° C.; the gas containing water and oil vapours is then led through the calcium carbide tube and an absorption vessel containing an ammoniacal solution of a cuprous salt. Care is taken to expel all traces of acetylene from the reaction tube by heating it to 250° C. for an hour before ending the experiment. The precipitated cuprous acetylide is then washed out of the absorption vessel, dissolved in sulphuric acid and the copper found gravimetrically as oxide. The analysis can also be carried out volumetrically by dissolving the cuprous acetylide in acidic ferric sulphate and titrating the ferrous salt formed with potassium permanganate. The percentage of water can easily be calculated from the weight of copper found. K. B. R.

40. INVESTIGATION OF AUTOMOBILE FUELS. APPARATUS AND METHODS FOR THE DETERMINATION OF SOLID RESIDUE, VOLATILITY AND UNSATURATES IN MODERN GASOLINE. P. H. Conradson. *Oil and Gas J.*, Dec. 2nd, 1926, 111.

In the first of two short articles the author gives directions for carrying out the Maumene or acid heat test. His method is slightly different to that usually quoted in standard text-books. Although the test is not strictly quantitative the results obtained show quite good concordance and the method is recommended for controlling the working conditions of cracking plants and thus ensuring the output of a uniform product.

The second article describes a form of apparatus for finding the gum residue and volatility of a cracked spirit. The apparatus consists of a modified form of the usual apparatus used for the coke residue test. A glass crystallising dish replaces the usual porcelain crucible and inlet and outlet tubes are provided in the lids of the outer crucibles so that a current of air may be drawn over the surface of the spirit in the dish. The outlet tube is connected to a condenser and vacuum receiving flask.

This apparatus was designed as a rapid method of estimating the gum residue and volatility of a cracked spirit for refining use. K. B. R.

41. THE VOLUMETRIC DETERMINATION OF HEXAHYDROAROMATIC HYDROCARBONS IN PETROLEUM AND TAR FRACTIONS. I. N. Danaila and V. Stoenescu. *Petroleum*, Feb. 1st, 1927.

The method used consists in the removal of the unsaturated part of the oil to be analysed and then by means of a catalyst, causing the decomposition of the cyclohexane and measuring the volume of hydrogen produced.

The apparatus consists essentially of a glass tube containing from 35 to 40 cms. of platinised asbestos, contained in a Lather Mayer air bath. To one end of this tube there are connected in parallel an apparatus for gene-

rating and purifying hydrogen and the vessel containing the oil under test, while to the other is connected a water condenser, a flask cooled in a freezing mixture and finally a graduated cylinder to collect the hydrogen generated.

The crude oil is first fractionated by a three-bulb Le Bel Henniger column and the fractions dried over calcium chloride and finally metallic sodium. The chosen fraction is then measured out, shaken with 98·33 per cent. sulphuric acid till free from unsaturated bodies, water washed and finally dried over calcium chloride and metallic sodium.

The apparatus is filled with hydrogen and the tube oven heated to 300—310° C. when the stream of gas is cut off and the measuring cylinder placed in position. The oil is now introduced at a rate of four to six drops per minute, the catalyst being maintained at 300° C., when the liquid products collect in the cooled flask leaving the hydrogen evolved to be collected by displacement of water. From the volume of hydrogen evolved is calculated the percentage of cyclohexane present.

From other fractions the content of corresponding homologues are obtained.

A. R. S.

42. Determination of Oils in Paraffin Wax. S. H. Diggs and C. C. Buckler. *Ind. Eng. Chem.* 1927. 19. 125—127.

The method described in this paper, of determining the oil content of paraffin wax depends on the use of the refractometer. The refractometer method had several advantages over the present press method. in that (*a*) it is capable of much greater accuracy for small percentages of oil, (*b*) it gives consistent results, and (*c*) less time is required to make a determination.

The simplest and most rapid procedure would be to determine the index of refraction of the wax sample and then by reference to a series of previously established curves (index of refraction—V—per cent. oil) to read directly the percentage of oil from the corresponding melting point. It was found, however, that the indices of refraction of "oil-free" waxes of a given melting point were not sufficiently constant to form the basis of a direct method of determination. The variation may be overcome by filtering each sample through a highly adsorbent clay in order to obtain the "oil-free" wax component. The refractive index of the latter will then establish the zero percentage oil point of a curve of refractive index—V—oil content. The relationship between the index of refraction and the percentage of oil can be established by making up mixtures from 0—100 per cent. of an "oil-free" wax and a "wax-free" pressed distillate and determining the indices of refraction at 60° C. This relationship which is not quite linear on account of the varying densities of the mixtures should be projected to a straight line on tracing cloth, in order to form a reference chart. Now if a straight movable arm be hinged at the 100 per cent. oil point, it will serve as any one of a series of graphs by merely raising or lowering the zero-oil-content end.

For refined and semi-refined waxes, namely, those containing less than 2·5 per cent. of oil, the refractive index is determined at 60° F. Then, about 50 g. of the sample are filtered through an approximately equal weight of Floridin filter clay and the index of refraction of the first few cc. of filtrate is determined. Reference is now made to the chart, the lower end of the movable arm is made to coincide with the value of the filtered sample at zero per cent. oil, and the oil content corresponding to the index of refraction of the sample is read directly from the chart. For samples containing more than 2·5 per cent. of oil—namely, crude scale and slack wax, it is only necessary to determine the refractive index at 60° C., and using a previously established value for the "oil-free" wax component, to read directly the oil content corresponding to the index of refraction.

W. H. T.

43. Measurement of Bloom of Lubricating Oils. L. M. Henderson and H. C. Cowles. *Ind. and Eng. Chem.* Vol. 19. No. 1, p. 74.

No satisfactory method of measuring the bloom of lubricating oils is known. The Ives tint photometer, which is used for measuring the colour of light reflected by opaque bodies, was considered a suitable instrument for the numerical estimation of the bloom of oils. Certain adjustments were made with regard to the intensity of light used and the angle at which the light struck the surface of the oil. The oil was contained in a crystallising dish which had been sandblasted outside and in and painted deadblack on the outside. It was found that elevation of the temperature decreased the bloom of paraffin distillate oils whereas in the case of cylinder oils a very much smaller decrease of bloom was observed. The bloom was always restored on cooling. The bloom of a 50 per cent. blend of a blue oil and a green cylinder oil was found to decrease very little on heating. The bloom of a number of oils was found and the results given in graphical form colour being plotted against absorption. K. B. R.

44. Viscosity and Temperature Changes. W. H. Herschel. *Oil and Gas Journal.* Dec. 2, 1926.

By means of the equation

$$(\log u - A)(t - B) = C.$$

connecting absolute viscosity and temperature, the author describes a method by which the viscosity over a temperature range may be obtained graphically. The curves have the temperature scale as abscissae and an arbitrary viscosity scale (which is produced by a graphical method in such a way that the relationship may be expressed by a straight line) as ordinate. The graphs given in the paper give Universal Saybolt viscosities, and are constructed for use with certain crudes and their products. The author considers that graphical reference as advocated here will give far more accurate viscosity values than could be obtained in ordinary laboratory tests. Similar graphs could be produced to represent the temperature-viscosity relation for other crudes. P. D.

45. An Improved Method of Organic Microcombustion. G. Kemmerer and L. T. Hallett. *Ind. and Eng. Chem.* Jan., 1927.

The heating units of the furnace consist of three electrically heated tubes and a small wire coil to cover the constricted end of the combustion tube. These units are capable of being moved as desired along the tube and each is controlled by a separate rheostat, the temperatures being recorded by pyrometers. The gas purifying train consists of a Pregl pressure regulator containing conc. sulphuric acid and a combined bubble counter and drying tube in which rubber connections are eliminated. The bubble counter contains sulphuric acid while the tube contains ascarite and phosphorus pentoxide. The combustion tube itself is a silica tube 53 cms. long and 7 mms. diameter filled with 3 cms. silver wool, 15 cms. finely broken copper oxide, 3 cms. silver wool, 4·5 cms. lead peroxide and 1·5 cms. silver wool.

The absorption tubes are of novel design, being made of pyrex glass and having each one ground glass joint for purposes of filling. They terminate in bent capillaries holding mercury globules which seal the tubes on rotating them through 90°. The water absorption tube contains magnesium perchlorate trihydrate, while the carbon-dioxide tube contains ascarite and phosphorus pentoxide. They are weighed full of oxygen, thus obviating the use of the air current to sweep the combustion tube. In the combustion

6 to 10 mgms. of substance are used and the furnaces heated to 900° C., 250° C. and 180° C. respectively, the rate of gas flow averaging 10 c.cs. per minute. Thus the combustion takes from 20 to 30 minutes. Data quoted show remarkable agreement between the results obtained by this micro method and macro methods. A. R. S.

46. A Sensitive Electrical Precision Apparatus for the Determination of the Boiling Point Elevation. J. N. Pearce and M. M. Hicks. *J. Phys. Chem.* 30, 12.

The apparatus described is a modification of that devised by Washburn and Read. Two exactly similar boiling vessels, both electrically heated, as placed side by side, one arm of a sensitive thermo-couple being introduced into each vessel. One vessel contains pure solvent and the other the solution under investigation, the thermo-couple recording the difference in temperature between the two flasks. The thermo-couple is calibrated by introducing two different pure liquids into the flasks and reading the potential set up owing to the known difference in the boiling points. Since the great need is for accurate calibration of the couple over a small range, one of the standard liquids should be the solvent, the other having a boiling point near that of the solvent. A method of analysis of the solution in the case of naphthalene in benzene, by measurement of the refractive index, is described. P. D.

47. A Rapid Method for the Determination of Sulphur in Certain Petroleum Products. C. S. Squire. *J.S.C.I.* Vol. 45. No. 53, p. 466T.

The author has devised an accurate and rapid method of estimating sulphur in light petroleum distillates, which it is claimed, will facilitate the control of refining processes. The following is an outline of the method :—A known quantity of sodium carbonate (in solution) is placed in an absorption tube together with an indicator. A weighed lamp containing the oil is lighted, and the products of combustion are drawn through the solution. The burning is allowed to continue until the sodium carbonate is neutralised, as shown by the colour change of the indicator. The flame is immediately extinguished and the lamp weighed again. The sodium carbonate is known to be equivalent to a certain quantity of sulphur ; this quantity is contained in the weight of oil burnt, and by a simple calculation therefore, the sulphur content of the oil can be deduced. Small quantities of sodium carbonate are easily used in the form of *N* 160 solutions, and if 10 c.cs. are used, an accuracy of 1 per cent. can be obtained. 1 gram. of kerosene can be burnt in about half-an-hour, so that the sulphur content can be determined in about 35 minutes. An inorganic indicator is used consisting of a mixture of potassium iodide and potassium iodate. It is advantageous to include the indicator in the standard sodium carbonate solution, so that only one measurement is necessary. The following solutions are used :—(*a*) For oils containing more than 0·25 per cent. of sulphur—N/80—sodium carbonate solution, each litre of which contains 38 gms. of potassium iodide and 5·3 gms. of potassium iodate. (*b*) For oils containing 0·06—0·25 per cent. of sulphur—N/160—sodium carbonate solution, each litre of which contains 25 gms. potassium iodide, and 3·5 gms. of potassium iodate. For oils containing more than ·25 per cent. of sulphur, and using solution (*a*) the results are obtained by simple calculation. 10 c.cs. of N/80—sodium carbonate solution are neutralised by 0·002 gms. of sulphur. The result is therefore given by the equation :—% sulphur = 0·002 + 100 ÷ wt of oil burnt. For oils containing between 0·06—0·25 per cent. of sulphur and using solution *b*, it is found that at about 0·13 per cent. the results obtained are correct.

Above this figure, the results are low, and below it, they are high, but as the errors are constant, it has been possible to construct a correction curve for the results between these values. W. H. T.

48. A Method or a Means for Determining or Comparing the Viscosity of Fluids. Knew Mill Printing Co. and T. L. Mort. E.P. 262,539. Dec. 16, 1926.

The means consists of a cup and ball, the cup being fitted to the end of a stem down the centre of which is screwed a rod, by means of which the distance of separation of the cup and ball can be varied. The instrument is dipped into the oil so that the ball adheres to the cup, withdrawn, and the time taken for the ball to disengage from the cup is compared with a standard time. The distance of separation is then altered till the time is the same as the standard time. Then a comparison of the distance gives a comparison of the viscosities of the oils. S. W. C.

49. Improvements in Viscosity Meters or a Method of a Means for Testing the Viscosity of Liquids. C. M. Larsen and C. L. Knopf. E.P. 262,652. Dec. 16, 1926.

The improvement relates to lubricating oils and particularly to motor car crank case oil. The instrument which is attachable to the crank case consists of two tubes, each containing a small sphere, the one filled with a fluid of known viscosity and the other being filled by a pump with crank case oil. The viscosities are compared by comparing the times of passage of the small spheres from one end of the tubes to the other. By this means the efficiency of the lubricant is quickly determined. S. W. C.

See also Abstracts Nos. 21, 22, 25, 26, and 30.

Refinery Plant.

50. Corrosion in Gasoline Manufacture. W. R. Finney and H. W. Young. *The Oil and Gas Journal*. Jan. 6, 1927.

This paper is primarily given in order to give an opportunity for its discussion at the February meeting of the A.I.M.M.E., and is a resume of the work done in attempts to cut down the corrosion losses on the Salt Brick Field Manufactories. It was first found that the raw water, used in the water jackets of the compressors and in the sprays on the cooling towers, caused the formation of scale and pitting thus reducing the heat transfer and shortening the intervals between cleaning plant. The first attempt made was to exclude as far as possible all air from the circulating water, then condensed water in absence of air was tried but both these measures failed to effect the desired result. Then followed attempts with circulating lubricating oil, alkaline lime-soda water, and silicate of soda in very dilute solution. The first was abandoned because of low heat transfer, while the second and third did not lessen the corrosion. A successful anti-corrosive water was found by dissolving about 2 pounds of potassium dichromate in 1,000 gallons of water, but later this was substituted by water containing 2 lb. sodium chromate per 1,000 gallons of water, on account of cheapness. Using this solution and making up to strength every fortnight, excellent results are being obtained. It has also been found that if distilled water to make up evaporation losses is unavailable at any time, raw water may be safely used as only scale formation results, and this scale gradually goes into solution again with recontinuation of use of distilled water. In conclusion it is stated that the most active factors in causing corrosion are increases in temperature, oxygen concentration, agita-

tion, mechanical strains in the iron and the presence in contact with the iron of metals or alloys electronegative to iron.

A. R. S.

51. Construction of Bubble Cap Towers. Fred C. Koch. *Oil and Gas Journal*. Jan. 20, 1927.

In this type of tower the object aimed at is to have equilibrium between the liquid on any deck and the vapour immediately above it. The greater the number of decks used, the less will be the reflux from each and consequently the greater will be the saving in fuel. There is, however, a certain minimum reflux beyond which it is not possible to go. While it is essential that most intimate contact be made between the vapour and liquid, it is inadvisable to have the serrations in the caps too small, as they would become closed up due to corrosion. Since on working, a froth several inches in thickness exists above the liquid surface on each deck, it is probable that most intimate contact occurs here. The decks should always be far enough apart to prevent entrainment of much liquid from deck to deck. The depth of liquid on each deck is limited by the allowable back pressure, and it is considered good practice to provide a liberal downflow pipe, to ensure even distribution of the liquid on the decks. The corrosive conditions encountered in bubble towers are often acute and are principally due to metallic salts and sulphur in the crude. The repeated evaporations and condensations at each deck hydrolyse such salts as magnesium chloride, with the consequent corrosion becoming more acute towards the top of the tower. When corrosion is to be expected, the parts should be easily removable and preferably be made of cast iron.

A. R. S.

52. Corrosion—an Economical Refinery Problem. H. F. Perkins. *The Refiner*. January, 1927.

Corrosion is defined as the inclination of a metal to return to its ore, forming soft soluble compounds. In oil refineries the main corrosive bodies are hydrochloric acid, and various sulphur compounds. The controlling influences are velocity of liquid, temperature, hydrogen ion concentration, metal potential, concentration of metal salts, formation of coatings, electrical conductivity, overvoltage of hydrogen, and oxygen, and in studying corrosion problems it may be possible to control one or more of these factors, thereby reducing corrosive action without great effort or expense. The most extensively used materials in refining plant construction are cast iron, wrought iron and steel. In special cases where it is desirable to reduce the frequency of failures, such metals as nickel, monel, aluminium, chromium and chrome-nickel steel are being used, and these appear to withstand the corrosive substances met with, so that their use seems likely to be extended as the costs become reduced. Laboratory testing of materials gives a fair indication of the proper metal to try, but of course does not give accurate quantitative data. By correlating the corrosion results on various metals and alloys as experienced, with those obtained by laboratory test, a fair idea may be obtained as to the principal corrosive agents present. Reporting corrosion in terms of depth per annum seems desirable, the pitting data, however, is harder to define consistently.

A. R. S.

53. Method of Recovering Hydrocarbon Oils from Oil Sands and the like. H. H. Armstrong. U.S.P. 1,607,977. Nov. 23, 1926.

The patent consists of a method and apparatus for recovering mineral oil from oil sand, limestone, shale, etc. The oil sand is induced to travel down a rotating spiral tray which is perforated. A liquefiable hydrocarbon gas or

butane (C_4H_{10}) is forced upwards so that it moves in contact with the oil sand, and counter-current to it. The gas dissolves in the oil, and reduces its viscosity and gravity, so that the oil-gas mixture can run through perforations in the spiral tray to a suitable receiving vessel. The extraction of oil can be carried out under pressure, and with heat if required. W. H. T.

54. Producing Residual Oil Products. U.S.P. 1,613,737, Jan. 11, 1927. Edward E. Bartelo, assr. Standard Oil Company.

The patent claims the method of forming a plurality of residual products by continuous distillation of hydrocarbon oils in a succession of stills. From one of the intermediate stills the lightest of the desired products is withdrawn, while the residue from the last still is the heaviest desired product. Intermediate products are obtained by blending. A. R. S.

55. Method of and Apparatus for Desulphurising and Fractionally Separating Petroleum. M. Benson. U.S.P. 1,607,043, Nov. 16, 1926.

The method consists essentially of mixing hot crude oil with superheated steam under pressure and allowing the mixture to expand. The vapours thus formed are then cooled in suitable fractionating columns in the last few of which suitable apparatus is introduced to remove the condensed water vapour formed. The apparatus consists of suitable means of mixing the steam and hot oil, which is then expanded into the separator, where solids and sulphur fall to the bottom and may be taken off. The vapours then pass on to Feld scrubbers, where fractional condensation takes place. The author claims that this method of distilling oil removes sulphur by hydrolysis of substances like mercaptans. The method renders cracking of the oil impossible and also avoids the dangers of open fires as well as the expense of cleaning and replacing ordinary stills. K. B. R.

56. Fractional Distillation. Richard B. Chillas, assr. to Atlantic Refining Company. U.S.P. 1,612,572, Dec. 28, 1926.

This patent comprises the use of a fractionating column, of any desired type, for the distillation of composite mixtures, in which the column is tapped at intervals and a portion of the refluxing liquid, proportional to the total liquid refluxing at that time, is drawn off, while the remainder returns to the column to be again used as refluxing liquid. The ratio of the amount of liquid removed, to that returned to the column, is arbitrarily fixed and operated by a mechanism, and it is claimed that this device eliminates irregularities in fractionation due to fluctuations in the rate of upflow of vapour in the column. A. R. S.

57. Oil Separator. James Conway. U.S.P. 1,608,016, Nov. 23, 1926.

A form of apparatus is described for separating crude oil from water, dirt and other impurities. This is done by forcing the crude oil through a number of small apertures at the bottom of a large vessel containing hot water. In rising to the top of the water the impurities drop out of the thin streams of oil and the clean oil can be run out at a suitably placed outlet tube. K. B. R.

58. Depulegomator. Walter M. Rose, assr. Gasoline Products Company. U.S.P. 1,612,265, Dec. 28, 1926.

The apparatus consists of a still having inlet and outlet ports. The entering gas encounters a horizontal partition in the lower portion of the still, through which a plurality of pipes terminating in elbow joints are fastened. The

condensate drops back into the space surrounding the pipes, to be drawn off by mechanically operated valves as desired, while the vapours passing upwards come into contact with the bottom of an open-topped container of less diameter than the still and suspended coaxially within it. In the annular space thus produced, the oil to be fractionated passes downwards, through a helical coil, on its way to the still, thus becoming heated by and condensing part of the counter current of vapour. At the top of the still is fixed a means for separating and returning to the inner container any liquid globules entrained in the liquid. A. R. S.

59. Distillation of Oils. D. R. Weller and L. Link. U.S.P. 1,609,007, Nov. 30, 1926.

A form of distillation apparatus for crude oil is described consisting of a still, three air-cooled fractionating columns and a tubular air condenser in series. The fractionating columns and air condenser are each connected to separate condensation systems and also the still by means of run-back lines. During the initial stages the vapours are fractionated in the three columns which are connected to the still, and pass through the air condenser and condensing system into receivers. This is continued until all the spirit and kerosene have been taken off. The heavier fractions are then collected from the bottoms of the first, second and third columns. When cracking takes place the cracked spirit is collected from the air condensers, the two middle columns being connected to the still, the first column being allowed to deliver its condensate. When the condensate reaches a certain specific gravity, owing to presence of amorphous wax, it is allowed to discharge into a "wax slop" receiver. The distillation is allowed to continue until the still is dry. This method gives very good fractionation and a separation of wax.
K. B. R.

60. Apparatus for Effective Continuous Distillation. F. M. Hess. U.S.P. 1,608,741, Nov. 30, 1926.

In this apparatus the crude, after passing through a heat exchanger, flows in a broad stream down pipes arranged in a zigzag formation. These pipes constitute the still and are heated by superheated steam. The steam passes in a counter-current direction to the crude oil, thus insuring effective and progressive heating. The vapours and condensates are led through the heat exchanger to a distributor, in which various fractions can be mixed with others or led to storage as desired. K. B. R.

61. Continuous Distillation of Oils. F. A. Howard and N. E. Loomis. U.S.P. 1,613,754. Jan. 11, 1927.

The invention provides for a battery of stills. Each still is externally heated and is provided with means whereby steam may be distributed throughout the mass of liquid, with heat exchanger tubes within the liquid and a vapour dome. Two methods of working are recommended. One wherein the vapour from the dome of one still is passed back to the heat-exchanging tubes of the preceding still, then condensed and the condensate withdrawn. The other wherein the vapour from the dome is passed firstly through the heat-exchanging tubes within its own still, and the uncondensed vapours from here being passed back to the heat-exchanging tubes of the preceding still, where they mix with the vapours from that still.
S. W. C.

62. Apparatus for Petroleum Refining. C. Jefferson. U.S.P. 1,609,822. Dec. 7, 1926.

The invention consists of a special form of dephlegmator divided into two main portions. A large number of vapour tubes pass from top to bottom through both sections of the dephlegmator. Oil vapours enter at the bottom section, pass downwards, and through the open ends of the heat-transfer tubes. The vapours then rise up the tubes where a certain amount of condensation occurs, and finally pass out of the dephlegmator by way of a pipe fitted at the top. The condensate gravitates down the tubes and is removed by means of a condensate outlet fitted at the bottom of the apparatus. Means are provided in the upper section whereby cooling liquid may be made to enter at the top, and pass by way of a series of baffles to the bottom of the top section. W. H. T.

63. Art of Distilling Easily-Decomposable Materials. W. K. Lewis. U.S.P. 1,590,827, 1926. Appl. Dec. 30, 1922.

Oils are distilled under reduced pressure in a vertical still which is heated throughout its whole length. Baffles of perforated metal are inserted to prevent priming and a cooling coil serves to condense a portion of the vapours, the resulting condensate being deflected into a conical pan and taken to a receiver instead of being allowed to return to the still. Means to operate battery of stills are described. H. G. S.

64. Dehydrator. R. H. Lindsay. U.S.P. 1,607,898. Nov. 23, 1926.

Crude oil is pumped through a pipe, recurved back and forth in a furnace where it is heated to 150° F. It is then forced up and flows over a pan, in the upper part of the furnace, where it expands and comes into contact with the air. This has the effect of segregating the water, which, as the oil flows down the pan, collects in the depressions placed transversely at intervals, from which it can be drawn off. S. W. C.

65. Improvements in the Process of and Apparatus for Manufacturing Active Carbon. Naamloze Vennoolschap Algemeene Norit Maatschappij. E.P. 242,659. Sept. 30, 1926.

Three types of kiln for the improved manufacture of active carbon are described.

Essentially the kilns consists of three zones—a heating, an activating and a cooling zone.

The activating zone has a number of apertures in the walls of the kiln for introducing the activating gases thus ensuring intimate contact with the carbon. The gases are removed from the carbon in the cooling zone and are led to the heating zone where they are utilised as a source of heat for the carbon entering the kiln.

The process is continuous and either carbonaceous material such as wood sawdust, etc., or carbon obtained by a previous dry distillation may be used as raw material. K. B. R.

66. Apparatus for Treating Hydrocarbon Oils. John P. Persch, Assr. to Martha E. Persch. U.S.P. 1,611,669 of Dec. 21, 1926.

The apparatus for the treatment of hydrocarbon oils by heated compressed air, so as to render the oils more mobile and thus better adapted for spraying as fuel, consists of a cylindrical vessel with a truncated conical bottom and draw-off cock. Fitted to the top of this vessel is a dephlegmator, con-

denser, and means of returning the volatilised oil to the vessel or removing it partly or in entirety from the system, as desired. Hot and cold air pipes are fitted to the vessel and these terminate in injector nozzles placed into the bottoms of a plurality of tubes fixed uprightly in the vessel and bent over at the top so as to discharge on to the oil surface.

The air preheated to the desired temperature is injected into the vessel containing the oil, thus forcing successive portions of the oil, intimately mixed with air, up the injector tube and so on to the oil surface, while the more volatile portion is carried up the dephlegmator with the air, to be returned to circulation by the air inlet tube. A. R. S.

67. Still and Process of Distilling. F. J. du Pont. U.S.P. 1,609,349. Dec. 7, 1926.

The object of the invention is to provide a still in which the disadvantages and expense of a deposition of asphaltic or carbonaceous matter during distillation, are overcome. The still consists essentially of a cylindrical vessel fitted with a cone shape base and mounted in a vertical position on a fire brick furnace. A wide coil of pipe leads from the bottom of the conical base, passes longitudinally through the furnace, and returns to the still by way of an annular chamber at the bottom of the still. The bottom half of the vessel is charged with lead which on being heated liquefies, and is circulated through the coil by means of a special pump placed in the circuit. In operation, the furnace burner is lighted, and the lead becomes fluid. Petroleum is introduced into the still, and due to its lower specific gravity, floats on the surface of molten metal. The metal in the coil is circulated by the pump from the coil to the still thereby transferring heat to the petroleum. The narrow ports by which the molten metal enters the still preclude any violent agitation of the surface of the metal such as would produce a vortex, and tend to carry petroleum down into the heating coil. As distillation proceeds, and deposition of asphalt-like products takes place, there is no surface for such products to adhere to and the only result of deposition is for the body of oil to become thicker. This it may do, almost to the point of solidity, without damage to the apparatus, and without presenting any problem or material expense in its removal. W. H. T.

68. Dehydrating Oil. John Primrose, Assr. to Power Specialty Co. U.S.P. 1,611,370 of Dec. 21, 1926.

The process consists in maintaining two separate bodies of wet oil, and in withdrawing wet oil from one body, heating it under pressure and subsequently allowing it to expand to large volume in a large tank so that the vapours generated are separated from the liquid, which is returned to the body of oil from which it was drawn until that body is sufficiently dehydrated. The offcoming vapour is in part condensed by causing it to give up heat to the body of oil not undergoing dehydration. The second body is then similarly treated, the dehydrated oil having been replaced by fresh wet oil. A. R. S.

69. Process for Purifying Oils and the Like. H. M. Ridge and W. R. Hodgkinson. U.S.P. 1,608,339 of Nov. 23, 1926.

Oils and particularly mineral oils may be freed of sulphur by passing the oil in liquid or vapour phase through a bed of a mixture of copper together with its halide and oxide. Methods of obtaining such a mixture are

described. It may be used in a finely divided state or the oil may be agitated with it or it may be deposited on bauxite, pumice or any other absorbent material. K. B. R.

70. Apparatus for Removing Sediment from Stills. W. F. Statham. U.S.P. 1,609,135. Nov. 30, 1926.

This patent describes a form of scraper for stills which collects the sediment into two rows down the length of the still and gradually moves this sediment down to an outlet in one end of the still. K. B. R.

71. Process of and Apparatus for Refining Oils. Charles Walcott. U.S.P. 1,613,298. Jan. 4, 1927.

This patent claims the use of a process and plant for refining oil in a still containing a maintained quantity of oil throughout distillation, by drawing oil from adjacent to the bottom of the still and discharging it by means of a plurality of nozzles, so that it streams over the inner surface of the still in thin laterally extending films. Thus a rapid circulation of oil is claimed which inhibits the formation of coke and increases the rate of distillation. A. R. S.

See also Abstracts Nos. 23, 85, 104, and 114.

Engineering.

72. Characteristics of Centrifugal Pump. M. D. Aisenstien. *Oil and Gas Journal*. Dec. 2, 1926.

Equations are given by means of which it is possible to predict the action of a given centrifugal pump from its known water characteristics. The author extends the equation giving the relation between the ratio of the gallons per minute of water and oil delivered, and the ratio of the kinematic viscosities, and finally gives an equation based on his experiments.

The problem of predicting the performance of a pump working in more than one stage is also discussed, and an illustrative example given. P. D.

73. Heavy Oil Engine Costs, 1925-26. Diesel Engine Users Association. *Gas and Oil Power* (1927) xxii., 75-77.

The number of stations furnishing data from this report is 37 Home (127 engines) and 9 Overseas (50 engines), the units generated being 36,069,571 and 23,783,192, respectively. The average engine cost per unit generated was :—

	Home Stations. d.	Overseas Stations. d.
Fuel	0·387	0·407
Lubricating Oil	0·057	0·077
Water (including treatment)	0·011	0·005
Stores	0·007	0·021
Wages (Running Staff)	0·200	0·127
Repairs and Maintenance	0·137	0·116
Total	0·799	0·753

The average fuel oil consumption per unit generated was 0·731 lb., and lubricating oil, 0·00149 gall. G. S.

74. Electro-Mechanically Operated Valves on Internal-Combustion Engines. *Gas and Oil Power.* Feb. 3, 1927.

In this invention as is usual in practice, the inlet valves are closed by springs, but in place of the conventional cam-shaft and tappets these valves are opened by the electro-magnetic action of specially-designed solenoids capable of lifting a mass of 100 lbs. through ·5 inches in ·025 seconds. Similarly the exhaust valves are held open by springs and closed by means of the solenoids. Thus very rapid valve opening is effected, minimising the tendency to throttling of the exhaust gases.

The current is supplied to the solenoids from a rotary distributor, being picked up by two independent sets of brushes, one set being used for each direction of rotation of the engine. Thus the engine can be rapidly reversed and run at full power in either direction. A. R. S.

75. An Exhaust-Gas Turbine. *Gas and Oil Power.* Feb. 3, 1927.

In this machine the turbine rotor is simultaneously used as an impeller for compressing the air, the latter flowing through passages in the turbine blades in a radial direction. This produces an effective and advantageous cooling of the rotor, and since both bearings are in the path of the incoming air, they also operate at low temperature. The fact that only one rotor is used reduces both the weight and windage losses, but the greatest advantage is that the critical speed is never attained because of the very short distance between the bearing centres. A. R. S.

76. Bituminous Pipe Coating Materials. Logan and Berger. *Oil and Gas Journal.* Dec. 9, 1926.

This article takes the form of the first report of the investigation, conducted by the American Bureau of Standards, into prevention of soil corrosion, and deals exclusively with bituminous materials. Those chosen are of two main classes, namely, from asphaltic and coal-tar sources, the specification laid down to the suppliers being that the coating material must be made from raw materials which were then commercially available in such quantities that they should be obtainable at the end of five years. Welded Bessemer steel pipes were chosen as the material to be covered, and these were pickled, water washed and thoroughly dried immediately before covering. The coating was accomplished by heating in tanks the individual selected materials to the temperatures desired, and then immersing the specimens until a complete covering of coating was obtained. Beside these straight coated specimens, others were made by wrapping the tubes with cotton fabric and then immersing as before, while some tubes were coated with a one-inch covering of crushed rock, sand, filler and asphalt.

These specimens were buried in various localities for periods of equal length, after which they were taken up for examination. In order to determine the condition of the pipes, the coating was scraped from one-half of the specimen, and the pipe washed in gasoline and then oiled, thus making allowance for isolated spots of corrosion. While the majority of specimens were found to be in good condition, some of the softer coatings appeared to have flowed after burial, while others showed unmistakeable corrosion of the pipe material. Asphalt and tar coatings behave differently, and show different indications of deterioration. Asphalts generally deteriorated by changing from a tough cohesive mass, to a short cheesy substance, and, in some cases even to a hard sandy pulverulent. Tar coatings, on the other hand, usually become hard and friable ultimately reaching a stage where they become like carbon particles.

In conclusion it is stated that thin bituminous coatings add somewhat to the life of the pipes, but in many soils they deteriorate and do not furnish adequate protection against soil corrosion. The bond between the pipe and coating seems to hold better in the pitch coatings, but certain of these are friable and easily scraped off. The thick pitch coating has a tendency to creep and flow, and thus allow stones to penetrate the coating. Reinforcing the pitch coating by wrapping the pipe with a loosely woven fabric which can be impregnated with the pitch adds materially to the value of the protection, by keeping the coating in place. There is some evidence of deterioration of the bituminous materials in some soils, and in such soils, a bitumen impregnated fabric coating will not afford permanent protection against soil action. A coating better than any of the dip coatings under test is needed for a number of soil conditions.

A. R. S.

77. The Optical Indicator as a Means of Examining Combustion in Explosion Engines. W. Morgan and A. A. Rubbra. *Automobile Engineer*. Jan., 1926.

The difficulties attending the use of the optical indicator in connection with high-speed internal-combustion engines are exhaustively dealt with. If the phase lag of the indicator for one particular event be determined, this leaves uncertain the phase lag of other events of the cycle. The serious effect of fluid friction in the rapidly moving gas in the tube connecting diaphragm chamber with engine cylinder is mentioned. The velocity of this gas is calculated in a specific case to be 350 ft. per sec. Hysteresis effects in the deflection of the diaphragm are mentioned as a source of error in estimating pressures. Creeping of the diaphragm was satisfactorily prevented by welding the outside edge to a holding ring, the inside edge of which was slightly proud of the rest of the clamping surface. Corrugated diaphragms were tried but proved inferior to flat ones. Cooling of the diaphragm by means of water spray on the back surface was found to be essential. Short period waves observed in the diagram during the combustion stroke were found to be due to explosion of the charge in the diaphragm chamber and connecting tube.

W. N. H.

78. The Effect of Hydrogen and Coal Gas, and of Reduced Intake-air Pressure on the Performance of a Solid Injection Oil Engine. G. F. Mucklow. *Automobile Engineer*. Nov., 1926, 463—471.

A single-cylinder Crossley solid injection heavy-oil engine, Type 0·23 was used, compression ratio 10·3 : 1. It was found that small quantities of hydrogen and of coal gas (up to 3 per cent. and 5 per cent., respectively, of the volume of air supplied) produced sweeter running than when no gas is supplied. Slight reduction in thermal efficiency and a slightly hotter exhaust are produced, but otherwise no ill-effects. At high loads with hydrogen, thermal efficiency is reduced 5·3 per cent., at low loads 10·9 per cent.; for coal gas the reductions are ·52 per cent. and 4·0 per cent., respectively, for each 1 per cent. of coal gas admitted. For each 1 per cent. increase of either coal gas or hydrogen the exhaust gas rises approximately 10° F. in temperature. The admission of either gas tends to slow down the rate of combustion, though the point at which combustion starts is uninfluenced. For hydrogen at all loads each 1 per cent. of gas reduces the maximum pressure by 4·3 lbs. per sq. in.; for coal gas at light loads this reduction is 8 lbs. per sq. in., and at heavy loads 4 lbs. per sq. in. By means of throttling, reduced intake air pressures were produced; it was found that rate of pressure rise is unaffected by throttling; the maximum pressure is decreased with reduction of suction pressure, heat losses to water jacket and exhaust are increased.

Brake thermal efficiency is reduced, at high loads this amounted to a reduction of 17 per cent., and at low loads to 4·4 per cent., when the suction pressure was reduced 2 lbs. per sq. in. Fuel consumption is increased; at high loads an increase of 20·7 per cent., and at low loads of 1·7 per cent. in fuel consumption was caused by decreasing suction pressure by 2 lbs. per sq. in. The amount of heat lost to the exhaust is proportional to the decrease in suction pressure, at high loads an increase of 255° F. and at light loads of 70° F. were observed when suction pressure was decreased 2lbs. per sq. in. With much reduced suction pressure and at heavy loads the exhaust gas became cloudy and dirty, probably with unburnt fuel. Reduction in suction pressure produces a longer interval between injection and the point at which rapid rise in pressure occurs at heavy loads this interval is increased 1·5 degrees crank angle, and at light loads ·9 degrees for each 1 lb. per sq. in. reduction in suction pressure. The fall of pressure during expansion takes place more slowly as suction pressure is reduced. W. N. H.

79. Improvements relating to Fire Prevention and Extinguishing Apparatus for Use with Petrol Tanks or Containers. L. Ingram. E.P. 262,697. Dec. 16, 1926.

The invention comprises a glass receptacle containing some chemical fire extinguisher which is placed across the top of the petrol tank and which can be broken by the impact of a plunger actuated from the driver's seat. S. W. C.

See also Abstracts Nos. 1, 29, 31, 33, 35, 52, 85, 99, 102, 105, 106, 107, and 108.

Anti-Detonation.

80. Increasing Volatility of Motor Fuel. G. G. Brown. *Oil and Gas Journal*, Nov. 18, 1926, 41.

Increased volatility in motor fuels can be produced (1) by cutting less deeply into the crude oil fractionated, (2) by greater use of the cracking process, (3) by blending with natural gasoline. The author examined the effect of blending motor fuels with natural gasoline. The latter is found to have an anti-knock effect equivalent to about one-half to one-third the effect of benzol. A large number of experiments were made with regard to ease of starting and acceleration, three six-cylinder and one four-cylinder engines were used in the tests. The ease of starting was in all cases proportional to the amount of natural gasoline in the blend, but little is gained by using a richer blend than 50 : 50. In moderately warm weather (60° to 70° F.) and an induction manifold heated by the full heat of the exhaust a 30 per cent. blend of natural gasoline with motor fuel gave the best acceleration at high speeds, and a 15 per cent. blend best at low speeds. In an engine whose induction manifold is heat by exhaust gases only when the throttle is closed, the greater the proportion of natural gasoline used, the better the acceleration. A blend of natural gasoline with a motor fuel of low end point was not found to be invariably better in performance than a blend in the same proportion of natural gasoline and a high end point fuel. As a general rule it was found that to give uniform performance an increase in 5 per cent. of natural gasoline should be added for every 5°F. below 70° in atmospheric temperature; any rise in atmospheric temperature about 70° could be neglected. More than 30 per cent. of natural gasoline should be added to a motor fuel only after careful testing regarding the maximum air temperatures which might be encountered as otherwise vapour locks may be formed. W. N. H.

81. Metallic Colloids as Suppressors of Detonation. H. L. Olin, G. D. Read and A. W. Goos. *Ind. and Eng. Chem.*, Dec. 18, 1926.

The anti-knock effect of colloidal metals suspended in petrol was estimated. A two-cylinder air-cooled motor cycle engine was used, running at a constant speed of 1,400 r.p.m. Temperature of the cylinder walls was determined. For any run the minimum load which will cause a knock is constant for a given fuel. A comparison of the loading at which knocking begins is a measure of the tendency of that fuel to detonate. Critical knocking loads plotted against temperature of cylinder wall gave a straight-line curve of constant slopes. Metallic colloids of nickel and lead were prepared in petrol, using rubber as a protective colloid and heating solutions of nickel carbonyl and lead tetraethyl respectively up to such a temperature that decomposition occurred. It was found in both cases that metallic colloids possessed no detectable anti-knock effect. W. N. H.

See also Abstracts Nos. 3, 24, and 77.

Cracking.

82. Gasifying Oil Fuels. *Gas and Oil Power*, Feb. 3, 1927.

This "The Goldebrough" process claims the complete gasification of even the low grade fuel oils. The apparatus consists essentially of a patent retort, heated externally to redness, and mixing chamber which supplies steam and air in the desired proportions along with the oil to the retort in an intimately mixed state. This stream passes through a spiral channel round the retort under gradually diminishing temperature and pressure, finally flowing into the gas-holder at the top. The nature of the catalyst in the retort is not stated. The gas thus obtained does not deteriorate on long standing and is found suitable for all types of engines as well as heating and lighting. A. R. S.

83. Process for Cracking or Converting Oils. O.P. Amend. U.S.P. 1,613,735, 1927. Appl. Mar. 3, 1922.

The process consists in heating heavy oils under a pressure of or exceeding 75 lb. per square inch by means of electric resisters of massive construction. The oil is preferably contained in a pressure still supplied with an efficient dephlegmator. Good results have been obtained by the use of electric resisters of carbon in the form of slabs 1½ in. thick, 6½ ins. wide, and 6 feet or more in length, the surface of the resisters being heated at from 800° to 1100° F. (427° to 593° C.). H. G. S.

84. Conversion Process. H. H. Armstrong. U.S.P. 1,613,010, 1927. Appl. July 9, 1923.

The heavy oil to be cracked is heated under pressure to a temperature slightly below that at which cracking occurs. This heated oil is then injected through an atomiser or exploder by means of steam and a highly heated gaseous or volatile hydrocarbon—*e.g.*, butane, into a converter which operates under slight vacuum. The heat required to crack the oil is supplied by the sensible heat of the injected gas. The converter preferably consists of a continuous pipe, the gas-steam mixture being injected at a number of points in the oil stream. H. G. S.

85. Scraper for Stills. J. H. Burlingham. U.S.P. 1,608,767, Nov. 30, 1926.

This invention describes a form of scraper for use in stills in cracking plants. The actual scraper is mounted on an arm in such a way that a chain with a

weight attached at one end keeps it hard up against the inner surface of the still. The form of scraper described in this paper is suitable for vertical stills, but can be adapted to horizontal stills. K. B. R.

86. Distillation of Oil. H. L. Doherty. U.S.P. 1,597,674, 1926. Appl. Nov. 22, 1926.

The primary object is to crack oil in such a way that the deposition of carbon can be controlled. To effect this, direct heat is applied in a pipe still only to the oil which contains no free carbon, the main bulk of the stock being cracked in compartments of a chamber, the heat to which is supplied by the sensible heat and the heat of evaporation of oil and vapours introduced therein. Further, the special apparatus described allows of the oil being thermally decomposed in stages of increasing temperature and pressure in order to submit the different constituents to the most favourable cracking conditions. The raw oil enters the system under pressure, flows through a series of preheaters into the first compartment of the cracking chamber, thence through a pipe still and separator into the last cracking compartment. The vapours which are disengaged pass successively through the other compartments in turn, the pressure being reduced in steps so that pressure distillation occurs, the vapours leaving the least-heated and lowest-pressure compartment being condensed and taken to storage. The residual oil from the last and hottest compartment is taken through a series of evaporators in which the pressure is reduced in stages, there being one evaporator for each raw stock preheater. The vapours liberated in each evaporator are passed through the appropriate preheater, the condensate being pumped into the raw oil stream leaving the preheater. The unvaporised oil emerging from the coolest preheater, after separation of heavy residium and cake, enters the first compartment of the cracking chamber and is pumped in succession through the other compartments in counter-current to the rising vapours. H. G. S.

87. Refining of Hydrocarbon Oil. G. Egloff and H. P. Benner. U.S.P. 1,608,089, Nov. 23, 1926.

This invention describes a method by which cracked light oils may be distilled in the presence of caustic soda and pulverised fullers earth to give water-white spirit and kerosene having a pleasant smell quite unlike that usually associated with cracked spirit. K. B. R.

88. Art of Distilling Oils. F. A. Howard. U.S.P. 1,612,289, 1928. Appl. Feb. 14, 1921.

The process consists in cracking heavy oils by distillation under a pressure of 4 to 7 atmospheres combined with the stripping of natural gas. The latter is injected into the vapour space of the still, the heavier distillates being refluxed and the gasoline condensed under pressure. The gas emerging from the apparatus may be scrubbed with gas oil which, when saturated with light spirit, is conducted into the cracking still. H. G. S.

89. Improvements in Means and Methods of Distilling. U. S. Jenkins. E.P. 262,666, 1926.

The continuous distillation or cracking of heavy oils, including crudes, is effected in a horizontal still which is fitted at each end with a downwardly directed sluice-way, each leading to a transverse drum, the two drums, one at a lower elevation than the other, being connected by means of tubes. The oil to be distilled or cracked is delivered into the upper portion of the longer sluice-way and flows by gravity, assisted by the action of a propeller located

in the sluice-way, through the tubes and eventually into the still from which vapours may be drawn off to a condenser. The heavy primary residues are continuously withdrawn from the two-sluice-way drums and from the bottom of the still and directed through a common main into a vaporiser, where the pressure is reduced and distillation allowed to take place. The residue (secondary) from the vaporizer now enters a settling tank, from the top of which heavy oil free from coke emerges, the final residue settling to the bottom. Baffles may be inserted in the vaporiser to assist distillation, and in the settler to minimise the movement of the oil. H. G. S.

90. Oils. Almer McD. McAffee. U.S.P. 1,608,329, Nov. 23, 1926

Petroleum spirit or oils are treated with hydrocarbon gases or hydrogen in presence of anhydrous aluminium chloride. Temperatures between 120°F. and 300° F. are used according to the volatility of the reactants. The author claims that this method saturates unsaturated hydrocarbons in cracked spirit and lubricating oils. Cracked spirit treated in this manner gives a spirit of any required unsaturation. As the gases formed during cracking may be made to combine with the cracked spirit formed, this treatment increases the yield of spirit from cracking plants. Gas oil on treatment gives lubricating oils, whereas lubricating oils on treatment acquire a higher viscosity and their colour and stability are improved while the volume of the oil is increased when hydrocarbon gases are used. Still gases or coal gas may be used as well as hydrogen or gases from cracking plants. An alternative method of carrying out the treatment is to mix the gases with chlorine and then lead this mixture into oil or spirit containing scrap aluminium. The aluminium chloride becomes coated with an oily layer of higher specific gravity than the oil which is being treated and is rendered inactive. It can, however, be reactivated.
K. B. R.

91. Process of Cracking Oil. C. Owens. U.S.P. 1,613,124, 1927. Appl. May 28, 1921. Renewed April 1, 1926.

The process consists in atomising the oil to be cracked by means of steam at atmospheric pressure and drawing the mixture by means of suction through a zone heated to cracking temperature and thence through condensers.
H. G. S.

92. Apparatus for Distilling and Cracking Crude Petroleum and Distillates. C. M. Page. U.S.P. 1,597,476, 1926. Appl. Aug. 26, 1920.

A pressure still heated by means of a furnace is provided internally with one or two cracking cells, each consisting of a double-walled metallic jacket enclosing a chamber containing electrically heated wires with metallic rods placed in a vertical position within the coils. The cracking cell is also supplied with a dome, the edge of which extends below a series of holes making communication between the cell and the still proper. An inlet and outlet pipe allow of a cooling medium to be passed from a source external to the still through the outer jacket of the cracking cell or chamber. In operation, the still is heated so that its contents are maintained under pressure and at a temperature equal to the final boiling-point of the produced desired. A high voltage, high frequency current is then passed through the coils so that the oil within the cells is cracked, the vapours rising into the dome escaping through the holes into the still and thence passing to the condenser. A continuous current of oil from the still to replace that cracked in the cell enters the latter through perforations in its base. Further, the nature of the

electric current and the arrangement of wires and rods induces an oscillating magnetic field, which produces a high molecular tension in the oil, causing cracking to take place with greater ease. H. G. S.

93. Apparatus for Cracking Oil, C.M. Page. U.S.P. 1,598,618, 1926. Appl. March 22, 1922.

The vapour space of a cracking still contains a number of auxiliary heaters so arranged that a flame plays upon a refractory material. H. G. S.

94. Process of Converting Oils. G. L. Pritchard and H. Henderson. U.S.P. 1,067,966, 1926. Appl. May 6, 1922.

The cracking of oils is effected by means of distillation in presence of aluminium chloride. High skin temperatures and consequent rapid coking are prevented by circulating hot oil or oil vapours through coils immersed in the charge and agitating the latter. H. G. S.

95. Improvements in Methods of and Apparatus for Cracking and Distilling Oils. Motor Fuel Corporation. C. F. Richey and P. T. Duffee. E.P. 235,564, 1925.

Oils to be cracked are passed through heated tubes of restricted cross section under such pressure—*e.g.*, 600 lb. per square inch—that the oil is maintained in the vapour phase. The hot synthetic crude next passes through a heat exchanger to preheat oil entering the system, and then through a cooling zone in which its temperature is reduced to atmospheric. At this stage the product enters a gas separator for the removal of permanent gas, and is immediately made to flow in counter-current to the hot oil traversing the cooling zone. By this means the crude product is distilled, steam being injected, if necessary, to control the degree of distillation required. H. G. S.

96. Apparatus for Converting Hydrocarbon Oils. B. B. Schneider. U.S.P. 1,609,001, 1926. Appl. June 12, 1925.

Oil to be cracked is pumped at a pressure of 400 to 500 lb. per square inch through a pipe still in which conversion is limited to about 10 per cent. The oil then enters a lagged or gently heated converter in which further cracking occurs, the vapours being taken through a dephlegmator and the heavy residues withdrawn. The dephlegmator is fitted internally with a cooling coil through which the cracking stock flows, the stock thus preheated then entering the pipe still of the next unit. The vapours passing the dephlegmator are condensed under pressure, whilst the reflux is made to enter the oil stream proceeding to the still. Means for operating a battery of units are described. H. G. S.

97. An Improved Process and Apparatus for the Conversion of Heavy Hydrocarbon Oils into Lighter Hydrocarbon Oils. H. T. Wright and F. Esling. E.P. 261,077, 1925.

A vapour-phase method of cracking is described, characterised by the fact that the lighter constituents of the heavy oil are cracked, the remainder being withdrawn and stored for subsequent treatment. In the preferred form of apparatus, the heavy oil is passed at a high velocity and under pressure through a pipe still in which it is heated but not cracked or vaporised. It then enters the top of a vertical evaporator which is heated sufficiently to cause only a portion of the oil to vaporise. The unvaporised oil is withdrawn at the bottom and taken to storage as heavy-oil cracking stock, whilst the

vapours are conducted under pressure, and at high velocity, through a heated tubular converter where cracking in the vapour phase takes place. Leaving the converter, the vapours are now expanded to substantially atmospheric pressure. Cooling thereby occurs, the carbon and heavy oil deposited being withdrawn at the bottom and the vapours taken through a dephlegmator. The condensate from the dephlegmator—*i.e.*, kerosene—is re-cycled whilst the vapours are condensed. The residue from the expansion chamber may be distilled to coke, the distillate being added to the heavy oil recovered from the evaporator: this combined stock is subsequently cracked in a separate operation. H. G. S.

98. Cracking of Bitumen from Tar Sand. G. Egloff and J. C. Morrell. *Oil & Gas. J.*, 1926, **25**, 192.

A sample of bitumen separated from Alberta tar sand by agitation with a hot dilute solution of sodium silicate gave on analysis Sp.G. 1:031, Sulphur 5·1 per cent., Water 2·5 per cent., Coke (by weight) 25·0 per cent. When distilled at an average temperature of 750° F. (399° C.) and under a pressure of 90 lb. per square inch, 56 per cent. of the tar was recovered as distillate, together with gas (1000 cubic feet per barrel) and coke (139 lb. per barrel). The pressure distillate having Sp.G.=0·831 and containing 40 per cent. of unsaturated hydrocarbons was refined with acid and plumbite and then subjected to steam distillation. The refined spirit, equal to 36·3 per cent. of the original bitumen, was water-white, stable and negative to the doctor and corrosion tests. Its analysis was as follows:—Sp.G. ·776, I.B.P. 42° C., endpoint 225° C., unsaturateds 27·2 per cent., aromatics 24·7 per cent., naphthenes 12·3 per cent., paraffins 35·8 per cent. The pressure distillate bottoms are suitable as a furnace, gas or cracking oil. The incondensable gas had B.Th.U. 1000 and the coke about 15,000. H. G. S.

See also Abstracts Nos. 20, 115, 116, and 117.

Oilfield Technology.

99. Steel Derrick Selection and Erection. Hallam H. Anderson. *Oil and Gas Journal* (1926), XXV. (30), 99—100.

The final work of the A.P. 1 Standardization Committee will result in the adoption of 11 instead of 430 steel derrick sizes. Six heights are provided for, and in five of these two sizes of base squares are given, as follows:—

Heights.	Base Square. Regular.	Uniform Taper.	Water Table. Openings (clear).
Ft.	Ft.	Ft. Ins.	Ft. Ins.
122	24	26 0	5 6
94	24	21 5	5 6
87	24	20 3½	5 6
80	20	19 1½	5 6
73	20	16 9½	4 4
66	20	— —	4 4

The tolerances are, height + 6 ins., base ± 2 ins., and openings + 2 ins.

Typical derrick height selections are:—The 122 ft. for deep rotary or deep production operations, where 88-90-foot fourbles of drill-pipe, 84-86-foot fourbles of tubing and 90-foot triples of rod are to be used. The 94 ft. for shallow rotary or combination drilling, where 67-69-foot triples can be handled.

Casing can be handled in 80-82-foot fourbles and for production 63-65-foot triples or 80-82-foot fourbles of tubing and 60-foot doubles or 80-foot fourbles of rods. The 87-foot derrick for deep cable drilling, handling casing in 60-66-foot triples, 63-65-foot triples of tubing, and 60-foot doubles or triples of rods. The 80-foot for cable drilling to handle 42-44-foot doubles of casing. The gradual elimination of this height in favour of the 87-foot is recommended. The 73-foot derrick for shallow production where doubles of tubing or 40-foot doubles of rods are handled. The 66-foot handling rods and tubing as for the 73-foot derrick, for jack-pumped production and light shallow wells.

A Two-derrick programme can be conducted by three methods. 1. Completely dismantling the drilling derrick and erecting the production derrick in its place. 2. Erecting a production derrick with a smaller base inside the drilling derrick prior to dismantling the latter. 3. By the use of a "dual" derrick, the upper section of which (usually 34-foot) can be disconnected and lowered on to an inner section of the original steel base. A.P. 1. dead-load and wind-load ratings have a factor of safety of 2, and the load values stamped on the nameplates should not be exceeded. First-class foundations are necessary for steel derricks and good 1 : 2 : 4 concrete is recommended. The ingredients per cubic yard are 6 sacks Portland cement, 0.6 ton clean sand, 1.10 tons clean sand, and 1 barrel clean water, the weight per cubic yard being about 2 tons. G. S.

100. Flooding Sands with Alkaline Solutions. R. C. Beckstrom and F. M. Van Tuyl. *Oil and Gas Journal*, Vol. 25, 34, pp. 34, 106–110.

This paper gives the results of a series of experiments on the flooding of oil sands with water, and various types and concentrations of solutions. The solutions employed were as follows:—Solutions of (*a*) neutral salts, (*b*) acid salts, (*c*) strong acids, (*d*) weak acids, (*e*) concentrated alkali, (*f*) alkaline hydroxides, (*g*) compounds of strong alkalies and weak acids (*e.g.*, Sod. carb., Sod. bicarb., borax, water glass, sodium oleate, etc.). With high-grade paraffin base oils, water flooding gave fairly high recovery until it became contaminated with oil. In the case of asphaltic base crudes, however, water flooding was very ineffective, due possibly to the fact that the asphalts and unsaturated compounds have a greater adhesion for sand grains than the paraffins. Solutions of neutral salts of variable concentration were ineffective, some even less than ordinary water. Strong acids acted as deterrents in every case, while weak acids even in very low concentrations, were no more effective than water. Concentrated solutions of alkaline hydroxides had little effect, but dilute solutions of hydroxides both alone, and in combination with certain other compounds tended to increase the yield of oil above that obtained by the use of water. Dilute solutions of salts of a strong base and a weak acid were most effective of all. Washing soda was found to be as effective as the chemically pure salt, a 1 per cent. solution proving to be the ideal concentration. A decrease in concentration below 1 per cent. rapidly diminished the effectiveness of the solution, except at higher temperatures. On the other hand, in the case of a field already flooded with water or where edge water is liable to creep in, the concentration of the solution should be increased proportionately to allow for this. The recovery obtained by flooding with dilute sodium carbonate solution is variable and depends on—(*a*) degree of saturation of the sand with oil, (*b*) concentration of solution, (*c*) temperature. Higher temperatures are more important for low-grade oils. (*d*) The amount of solution passed through the sand. The yield of oil is much higher in the early stages of flooding than in the later stages. (*e*) Type of oil in the sand, (*f*) texture, porosity, and continuity of openings of the sand, (*f*) uniformity of oil sand, (*g*) type and quantity cementing material in

the sand. The total recovery of oil in the experiments ranged from 50–90 per cent., using sands 50 per cent. saturated with oil. In actual field practice, however, a recovery of not more than 80 per cent. is to be expected.

W. H. T.

101. Results of Gas Lift Operations obtained in California Field. Frank F. Hill. *Oil and Gas Journal* (1926), XXV. (30), 106, 116.

In 1914 a patent was secured for circulating gas into oil wells, extracting gasoline from the gas, and reintroducing the gas into the well. Experiments during the last two years in Santa Barbara County have produced sufficient records to prove that gas lift is a success under favourable conditions. Such conditions are usually found in flowing wells, in wells which have just passed from flowing to pumping, or in wells where a reasonable fluid head exists. Gas lift has been operated successfully at depths in excess of 5000 feet, and also in wells producing oil and water where the water alone could not be pumped with the ordinary working barrel. The system is so new that the question of increase in ultimate production cannot yet be answered.

G. S.

102. Recommended Practice for Use in Storage and Care of Cordage. J. S. McDaniel. *Oil and Gas Journal* (1926), XXV. (30), 86, 114, 116.

Damage which shortens the life of manilla cordage may be divided into three general categories, (*a*) mechanical, (*b*) chemical and (*c*) climatic or storage.

Mechanical.—The most common is surface wear by dragging. Cordage dragged over the ground picks up grit which is converted into an abrasive. In hoisting work unnecessary wear is occasioned by rubbing on beams, edges of blocks, etc. Internal wear and breaking of fibres may be caused by sharp bending over small pulleys. Rope should never be overloaded, a good rule being not in excess of 25 per cent. of full capacity. A dry rope held taut should be slacked off if it becomes wet, as the fibre swells when wet, and this tends to shorten the rope. When uncoiling rope, care should be taken to avoid kinking. A fishing job often seriously injures manilla cable, as excessive pulling destroys the elasticity of the fibres and the spring of the lay.

Chemical.—Commercial acids, such as sulphuric or uric, are a cause of many rope troubles, and all rope should be kept well away from acids and as dry as possible.

Climatic or Storage.—Rope should be stored in a dry, well-ventilated warehouse kept as cool as possible, and arranged to allow of air space between rope and floor. In the field, rope to be stored should be washed, dried in the sun and covered to keep out damp. Free circulation of air round the rope is essential. Wet rope should never be allowed to freeze. If this happens, it should be thawed out and dried thoroughly.

G. S.

103. Restoring Pressures with Air; Increases are Well Worth While. J. E. Roth. *Oil and Gas Journal* (1926), XXV. (30), 88, 96–97, 102.

To adequately cover a property with pressure takes about one well in five, as a pressure well, the cost per well ranging from about $500, for plants of 60 to 90 wells, to $300 for 350 to 450 wells. At the start every alternate pressure well is equipped, the remainder being added as convenient.

In most cases, packers are set just above the sand to confine the pressure to the sand. An improvement is to run a couple of joints of 4-inch on the tubing, and cement this in.

Several instances of increased production by the use of pressure wells are given. It is considered from decline curves that by ordinary methods production in the next ten years would be less than 1 per cent. of the oil-content of the sand, while by the use of pressure the production would be increased to 3 or 4 per cent. G. S.

104. Process of, and Apparatus for, Dehydrating Crude Petroleum Oil. H. O. Ballard. U.S.P. 1,600,030. Sept. 14, 1926.

In this apparatus crude oil emulsion is heated to 140° F. and conducted through chambers in a thin stream. The floors of these chambers are fitted with a series of small baffles set in narrow furrows. The oil flows at a very slow rate, and the water settles out in the furrows, and is removed.

Some unbroken emulsion is removed with the water and is led into a further set of chambers after having been heated to 200° F. A separation takes place again. Emulsion left in this case is separated in a centrifugal separator. All the chambers are fitted with take-off pipes and condensing systems to prevent loss of low boiling fractions. K. B. R.

105. Improvements in, and Relating to, Overshots for Use in Well-Drilling Operations. J. F. Cailloux. E.P. 263,057. Dec. 23, 1926.

The patent describes a special form of fishing tool which comprises a hollow body fitted with a slip seat, the latter being supported by a shoulder on the inside of the main body tube. The slips are held on to the slip seat by means of a spring which presses a packer on to the top of the slips. The tool itself is so constructed, that the passage of a pipe joint into the slips is prevented, while the upward movement of the packer against the spring is limited. The claims of the patent are that displacement of the rubber packing ring with respect to the slips, is prevented ; that it is impossible for a pipe joint to enter the slips, and that the provision of a spring and spring shield, enables the packing to be held in position permanently. The spring shield prevents contact of the spring with any jagged upper end of pipe and is easily removed for the purpose of cleaning the overshot. W. H. T.

106. Improved Means for Raising, Lowering or Otherwise Handling Casings Rods or the Like in Wells. Dunn Manuf. Co. E.P. 249,807. Dec. 16, 1926.

The device consists of two members, interlocking and hinged together, the hinge being provided with anti-friction devices to aid in the raising and lowering of the gate. The gate is held securely in position by the co-engagement of a T-head and lugs. S. W. C.

107. An Improved Device for Supporting Casings and the Like in Wells and Boreholes. J. Grant. E.P. 262,310. Dec. 9, 1926.

It is the practice to support well casings by means of a spider equipped with wedge pieces for gripping the pipe. When it is desired to lower the pipe into the well, it must first be raised before the wedges can be removed. It is the object of this invention to provide a spider in which the wedges can be removed without having to raise the casing. The spider described in the invention consists mainly of three parts, the wedges, the main body of the spider, and a collar which actually holds the wedges, and rests on the lower main body piece. Large lugs are constructed in the lower portion of the spider which correspond to similar openings on the upper collar. The lugs and openings have sloping sides so that a turning motion on the collar will

tend to raise it from its seat on the main body piece, while a turn in the opposite direction will lower the collar on to its seat. Now the normal position of the collar while the casing is being held, is that in which it is raised from its seat. Means are provided in the invention whereby the collar can be held rigidly while in the elevated position. When it is desired to free the wedges from the pipe, preparatory to lowering the latter, the locking device must first be released, and then the collar rotated so that it is lowered on to its seat on the main body portion the lowering of the collar automatically removes the wedges, and loosens their grip on the casing, so that the latter may be lowered further into the well. W. H. T.

108. Improvements in Spudding Shoes for Use in Well Drilling. E. C. R. Marks. E.P. 262,650. Dec. 16, 1926.

A new spudding shoe is claimed having detachable cable engaging surfaces, a safety device to prevent the spudding shoe flying off the cable in the event of the jerk line breaking, and an anchoring device to prevent the shoe climbing the cable. S. W. C.

See also Abstracts Nos. 4–19 (Russia), 53, 57, 68, and 112.

Petroleum Geology.

109. The Ural-Emba Oil Area. Anon. *Oil News*, 1926, 20, 779–780.

The Ural-Emba oil region embraces a wide stretch of desert country starting on the N. shore of the Caspian sea and extending approximately, 400 km. to the N.E. as far as the Orenburg-Tashkent railway. Except in the southernmost portion the oil deposits are bounded, roughly, on the west by the rivers Vil and Sagiz, on the east by the river Emba. Although oil indications are very numerous over the whole of this region, production has hitherto been limited to the gushers at Dossor and Makat; the first of these to be brought in was that at Dossor, during 1911. The oil occurs in the lagoon Jurassic deposits, in from two to four horizons. The depth of the oil-sands varies laterally; thus at Koi-Kara (in the centre of the district) oil is found as high as the lower beds of the Upper Jurassic, where somewhat to the westward, at Dossor, it extends as high as the Upper Volga series. The lagoon Jurassic comprises greyish clays interbedded with thin layers of light-coloured sand, black bituminous clays with scanty lignite layers, and grey argillaceous sand and sandstones, the clay strata predominating at all levels. At Dossor and Makat the total thickness of the lagoon Jurassic reaches 320 to 360 m. It rests upon coarse sand and pebbles infrequently interbedded with clay, some 185 to 200 m. thick. In the central zone Tertiary beds are particularly widely distributed; in the Caspian area greenish-grey calcareous clays and argillaceous sands are found, resembling those of Baku and the Apsheron peninsula. These beds, of considerable thickness, form a cover with practically level upper surface. Domes, with flanks sloping at 10°—21° and a breadth to length ratio of 1·25 : 3, are found over the whole district. The direction of strike is indefinite and unusually variable, but exhibits a tendency towards N.N.W. W. S. N.

110. The Transcaucasian Oil Regions: Tiflis—Gaudja. N. Khaliaev. *Petroleum Times*, 1927, 17, 35—36 and 181—182.

The oilfields of the Tiflis region are situated in the neighbourhood of the Kakhetia ridge, mostly in the valleys of the Alayan and Iora rivers. The Kakhetia ridge is a watershed between these two rivers and extends for 100

to 170 kilometres from S.E. to N.W., joining the main Caucasus range in the N.W., and ending in the S.E. near the Lagbe river. The Kakhetian region contains beds of Post-Tertiary, Tertiary, and Cretaceous age, the Tertiary being the most highly developed. Shewings of oil are only to be found in the Tertiary sediments, being encountered in rocks which range in age from the Upper Miocene to the Eocene. The most pronounced indications of petroleum are observed in the Eocene, notably in compact calcareous sandstones and micacious clays of the Upper Eocene, and marls and limestones of the Middle Eocene. The geological structure is complex and consists of a number of anticlines, seemingly of the "diapir" type, which are complicated by secondary folding and faulting. Outcrops of igneous rocks can be observed along the axial line of the Kakhetian ridge, while numerous oil seeps accompanied by gas and salt water are found in association with eroded and fractured rocks of the Paleogene. Despite explorations accomplished by certain geologists, the Tiflis oil deposits still remain insufficiently explored, and their commercial value so far cannot be estimated. Again, the development of these oilfields was suspended owing to the lack of technical supervision in drilling operations, and to the want of capital. The crude oil of the Tiflis region has a specific gravity of 0·885, contains up to 25 per cent. of benzine, and about 32 per cent. of kerosine, while its sulphur content is quite low.

W. H. T.

111. Experiment on the Dehydration of Gypsum. J. T. McCormack. *Journ. Geol.*, Bol. XXXIV., pp. 429—433.

The paper gives details of experiments which have been carried out in order to determine the effects of pressure on the dehydration of gypsum to anhydrite at various temperatures. Pressure up to 316,000 lb. per sq. inch was used, corresponding to pressure produced by a column of limestone more than 250,000 feet high, but no noticeable dehydration took place in the course of three hours. Smaller pressures up to 36,000 lb. per sq. inch, acting for five days, gave no sign of any dehydrating effect. At a temperature of 150°C, however, the change from Gypsum to anhydrite was completed in five days, the application of pressure making very small difference to the speed of the reaction.

W. H. T.

112. Movement of Fluids in Porous Solids. P. G. Mulling. *Oil and Gas Journal*, xxv., 31.

This paper is primarily a record of analytical and experimental investigation on the flow of liquids through such substances as sand in varying states of fineness and sandstone, but it should prove of interest to those who have to deal with the flow of liquids through any type of medium having irregular pores. The experiments described are of a simple nature. A column of the specimen of constant cross section is allowed to dip just below the surface of the liquid and the rate of rise of the liquid under the force of capillarity is noted. The constants so obtained are arbitrary, but are useful in calculating the mean flow of liquid under any given conditions of pressure. The behaviour of any particular specimen must be determined experimentally and cannot be predicted theoretically.

P. D.

113. The Berekei Oil Region. By A. Pritula. *Petroleum Times*, Dec. 11, 1926, p. 1,071.

The Berekei oilfield is situated in the Caucasus, on the coast of the Caspian Sea, halfway between Grozny and Baku. The field is situated in a low coastal plain, the nearest mountains being 13 kilometres to the west. The geology

of the district has been dealt with in detail by Golubyatnikov. The uppermost formations are Post-Tertiary, and rest on a quicksand, with a considerable flow of water. Underlying the Post-Tertiary deposit are dark clays of the second Mediterranean Stage (Middle Miocene). These clays have a thickness of 1500—200 metres and contain moderate seeps of oil and gas. The middle Miocene deposit is followed by strata of grey and dark clays and clay shales containing scales of fish, and relating to the Maikop beds (Lower Miocene and Upper Oligocene). In the upper 200 metres of this formation there are feeble seeps of oil and gas. An interbedded layer of globigerina marl has produced several big gushers, it seemingly lies within the Maikop beds, and is younger than typical foraminifera beds of the middle Oligocene developed throughout the North Caucasus. The horizons of the Middle and Lower Oligocene as well as of Eocene have not yet been tested with the drill, but there is reason to believe that deeper drilling into the above mentioned formations may disclose loose sediments which may serve as a reservoir for more or less considerable accumulations of oil. The main structural feature of the Berekei field is an anticline trending in a north-western direction, with its north-eastern flank dipping at an angle of 28—30°. Drilling operations have shewn that four horizons are petroliferous, but they are not uniformly saturated with oil. In the Spiralis beds, and in the grey shales underlying them, a thick oil has been encountered at various depths. Considerable quantities of oil have been obtained from the globigerina horizon, and some wells have been gushers. Other wells, however, yielded only showings of oil, this being attributed to the unsatisfactory methods of shutting off water. Water-bearing strata are the chief impediments to the development of the Berekei field. W. H. T.

See also Abstract No. 100.

Coal and Shale.

114. Report of Tests by the Director of Fuel Research on the Freeman Multiple Retort of the British Oil and Fuel Conservation, Ltd., Willesden. Dept. of Sci. & Ind. Res., H.M.S.O., 1926.

The retort examined by H.M. Fuel Research Board consisted of six cylindrical cast-iron chambers 18 ins. deep and about 5 feet in diameter placed vertically above one another. A central shaft passed through the retort and attached to it in each compartment was a circular plate which rotated with the shaft twice every three minutes. The crushed coal, which was fed in at the top through a star valve, dropped on to the first revolving plate and was pushed by means of ploughs attached to the upper side of the chamber to the floor, thence by means of ploughs on the underside of the plate into the second and by similar means into the subsequent chambers. Four off-takes at regular intervals round the top of each chamber served to remove the products of distillation. Heating was effected by means of gas jets placed under each chamber, and was so controlled that the coal increased in temperature by definite stages from 100° C. in chamber 1 to about 600° C. in chamber 6. Various alterations in the design of the ploughs, etc., were found necessary. A non-caking coal, Kirkby Top Hard, in the form of washed slack and of dry nuts was first carbonised, followed by "Brynna" Gas Coal, an indifferently caking-coal, and lastly by "Washed Waterloo Slack," a medium caking coal from Chesterfield. The weight of material treated in each run varied from 7·5 to 15.7 tons, and the duration of the tests from two to three days. Weight and thermal balances showed losses on the former varying from 1·29 to 3·2 per cent., and on the latter from 3·8 to 8·4 per cent. The yields of products per ton of "Kirkby Top Hard"

and "Brynna Gas Coal" respectively were:—Coke, 13·4 and 14·7 cwt.; gas, 1610 and 1720 cu. ft.; tar, 20·2 and 18·6 galls.; liquor, 40·3 and 21·7 galls.; crude spirit from gas 0·74 and 0·97 galls.; ammonium sulphate, 2·1 and 1·7 lb. In the test using "Washed Waterloo Slack" the retort quickly choked. The coke produced was readily combustible but was in the form of breeze. The yield of tar, which was of a very fluid nature, was high, representing over 80 per cent. of that obtained in the Gray-King assay apparatus. The gas, produced in small yield, was a typical low temperature gas of high calorific value. A laboratory examination of the tar gave the following yields in gallons of refined products per ton of coal carbonised:——Motor-spirit, 0·99; naphtha, 0·65; burning oil, 1·69; gas oil, 1·15; lubricating oil, 1·46; tar acids, 4·66; tar bases, 0·20; total, 10·80; pitch, 87·5 lb. H. G. S.

115. The Hydrogenation and Liquefaction of Coal. Part IV. The Hydrogenation of Cannel Coal. D. G. Skinner and J. Ivon Graham. *Fuel*, 1927, VI. 74–81.

Cannel or boghead coal from the Lower Dysart Seam, Fifeshire, and a South Staffs. Thick Coal cannel were subjected to distillation experiments in the Gray-King assay apparatus and also to thermal treatment under high pressure in presence of hydrogen and nitrogen respectively in the autoclave previously described (*cf. J.*, 1925, 35A, 104A, 188A). The results, given in great detail, are compared with those obtained in earlier work on South Staffs. durain. The distillation experiments were carried out at 450°, 600°, and 900° C., and the percentage yields of tar at these respective temperatures were:—Fife cannel, 34·4, 39·75, 39·85; South Staffs. cannel, 21·0, 21·75, 21·80; Durain, 8·1, 9·55, 9·85. The yields of water, coke, ammonia and gas and the compositions of the last named are also given. In the high-pressure experiments, 200 grams of the powdered cannel were heated with hydrogen and nitrogen in separate experiments for two periods of four hours each; the residual gas when hydrogen was used being replaced by a fresh batch of hydrogen before the second treatment. Also in the case of South Staffs. cannel (and durain) phenol was used as the excipient. The autoclave products were first distilled to 150° C. to remove light spirit and water, and the residue then resolved into (*a*) phenol insoluble, (*b*) phenol soluble, chloroform insoluble, (*c*) phenol soluble, chloroform soluble constituents. It was found that reductions of pressure occurred during hydrogenation and increases of pressure when the treatment was carried out in presence of nitrogen. Conversion to liquid products, expressed in gallons of tar oil per ton of coal, were as follows, taken in the order of (*a*) hydrogenation, (*b*) high-pressure nitrogen treatment, (*c*) assay or destructive distillation. Fife cannel, 94, 88, 99; South Staffs. cannel, 79, 26, 54; South Staffs. durain, 80, 17, 24. Hydrogenations of the low temperature tar fraction to 450° C. from the Fife cannel and of the same in presence of semi-coke were also carried out. Iodine values of all the distillates to 300° C. from the cannel coals showed that the hydrogenated oils were only slightly more saturated than those from the blank (nitrogen) experiments, but considerably more so than those from destructive distillation. H. G. S.

116. Improved Process of Obtaining Hydrogenation Gas for Hydrogenating Coal and Hydrocarbons from the Waste Gases of the Hydrogenation. F. Bergius. E.P. 244,730, 1925.

The gases resulting from the hydrogenation of coal, oils and the like under high pressure (berginisation) consist mainly of hydrogen, but contain also

methane and its homologues, nitrogen, carbon monoxide, carbon dioxide, etc. Hitherto, these waste gases have been utilised as fuel, but the invention describes a continuous method of recovering both the free and combined hydrogen to render it suitable for use in the main process. The gas is first scrubbed to remove successively light spirit and hydrogen sulphide. The residue is then mixed with steam and passed through a superheater maintained at about 1100°. The issuing gas, which now contains carbon monoxide but no hydrocarbons, is cooled somewhat, mixed with a further quantity of steam, and conducted through a catalyst—*e.g.*, iron oxide, heated to between 300° and 500°. This treatment converts the carbon monoxide into the dioxide, the whole of which is removed in any known manner. The remaining impurities, chiefly nitrogen, cannot be eliminated economically, but their content is maintained at a minimum by periodically removing from circulation a sufficiently large portion of the total gas. H. G. S.

117. Process for Hydrogenating and Cracking Hydrocarbons, Carbonaceous Matters and the Like. F. Bergius. U.S.P. 1,607,939, 1926. Appl. April 5, 1924.

In the process of hydrogenating oils or carbonaceous matter under high pressure, the gases emerging from the reaction vessel are rich in hydrogen, but not sufficiently so for purposes of hydrogenation. Purification, however, can be effected by passing them, whilst still under pressure, through mineral or tar oils which preferentially dissolve the methane and higher hydrocarbons. The latter may be liberated by heating, or reducing the pressure on, the wash oil, and if cracked at high temperatures are decomposed into carbon and hydrogen. The wash oil may thus be used repeatedly whilst a considerable economy in the use of hydrogen is effected. H. G. S.

ABSTRACTS.

Arranged by W. H. Thomas, A.R.S.M.

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General.

110. An Outline of the Law of Chemical Patents. Edward Thomas. *Ind. Eng. Chem.*, 1927, XIX., Nos. 1–3, pp. 176–180, 315–317, 426–429.

This article is based on the author's forthcoming book on "The Law of Chemical Patents."

A United States patent, which runs for seventeen years from the date of its issue, consists of three principal parts: (1) A contract signed by the Commissioner of Patents. (2) A specification by the inventor disclosing his invention. (3) One or more "claims" defining the invention.

A chemical invention differs fundamentally from a mechanical invention, being what the statute refers to as a patentable discovery. In a case concerning a dye it was said that "A discovery to be patentable must have the attributes of an invention." A discoverer "may not understand the law upon which the process operates . . . if he be the first to give the world as a result of his method a new and valuable article of manufacture he is entitled to protection."

There is a wide difference between the invention of a new method and the discovery of a new compound. In the former, only the process can be patented. In the latter, both the process and the composition are patentable.

The specification is the foundation of the patent and the claim is the definition of that which is described in the specification. In drawing up a patent specification, two difficulties arise: (1) the description is written at an early stage in the commercial development of the invention, and (2) in law there is often no invention in the vital novelty of the discovery. In various Court cases the following remarks have been made: "The scientific principle is not part of the process." "A patentee may be baldly empirical." "Theories do not control the decisions in patent cases." "It was not essential that they should either understand or set forth the principle on which their process operated." "It is not the personal intent or understanding of the patentee, but the actual facts regarding the invention that are material."

The description of an invention in a patent must enable those skilled in the art to reproduce it with reasonable certainty. Errors, if not vital, will be overlooked, but vital errors are fatal.

The nature of invention has been summed up as "Invention therefore, in the economic sense, is clearly a product of imagination, which will pass the social test of use within the bounds of expense of production, limited by the value of that use." Another point of view is, "A conception of the mind is not an invention until represented in some physical form."

On the question of joint inventors, a decision has been given that ". . . the conception of the entire device may be due to one, but if the other makes suggestions of practical value . . . he is a joint inventor."

As regards novelty in view of prior art, it has been said that wherever a change, however small, is made and results in marked advantages, a patentable invention has been produced. The obtaining of a new product is not necessary to patentability.

The application of an invention to an analogous art has been considered insufficient for the granting of a patent. Mere improvement is also not enough for patentability and trivial, unrecognised, accidental prior use does not anticipate a valuable invention. Incomplete or imperfect prior experiments do not defeat a patent.

To be patentable, a product or composition must have definitely new characteristics. There is a wide difference in discoveries and other inventions in the substitution of materials. "The substitution of one material for another in a door knob is the work of the mechanic, the substitution of one material for another in secondary battery electrodes may solve a problem which will revolutionise the motive power of the world."

Prior publications are important in respect of chemical patents. In one suit, the Court said, "When it is sought to ascertain the state of the art by means of prior patents, nothing can be used except what is disclosed on the face of those patents. Such patents cannot be reconstructed in the light of the invention in suit, and then used as a part of the prior art."

In one interesting decision it was found that a journal account of prior experiments were insufficient to constitute an anticipation, but the account of other experiments were sufficient to anticipate certain phases of the invention. In another case it was considered that a prior publication was insufficient to support a patent. Blanks were left where proportions should have been stated with accuracy.

As regards suggestions of prior writers being regarded as anticipations, one Judge said "the alleged prior art necessary to negative invention must be clear." In another case the Judge said, "The law requires something beyond mere suggestion to defeat a patent."

Reduction to practice in a foreign country cannot destroy a patent, unless the invention be patented or published. A trade circular is not necessarily a publication.

Trade secrets are generally protected by the Courts, but when the right of a trade secret or a patent right have to be held paramount, the decision has usually been in favour of the patent.

No patent is complete without a claim, and it is advisable to have several broad claims. All claims should be supported by the specification.

It is an infringement for an unauthorised person to make a patented article for use or sale, even if the article is not in fact used or sold. If one of a series of acts constituting a process are omitted, there is no infringement unless an equivalent act is substituted.

An improvement may infringe a patent, and it has been laid down that "The introduction of an improvement gives no title to use the primary invention upon which the improvement is based." When an improvement is patentable "The prior patentee cannot use it without the consent of the improver, and the latter cannot use the original invention without the consent of the former."

The inclusion of product claims as well as process claims in a patent are advisable as a process patent is not infringed by selling the product.

On the point of chemical equivalents, a judge has said: "I think the law must be that where the new ingredient is such as would have been known to or employed by the ordinary skilled practical chemist . . . it is covered by the patent."

Infringement may be indirect, or contributary, by making it possible for another to infringe.

A full description of a discovery should be included in the patent application as originally filed. Claims struck out by amendment are assumed by law to be conceded as no part of the invention.

There are two methods of amending a patent after its issue, by disclaimer or by reissue.

A patentee's second patent for a given invention is void, unless the patent is a reissue, on account of "double patenting."

In the absence of a specific contract, an employer has no rights in the invention of an employee, beyond a "shop right," which have rarely been applied by the Courts.

Where two inventions can be described by the same claims, steps are taken to incorporate them, and an "interference" ensues, the claims being the basis for determining the prior inventor.

The burden of establishing an infringement rests with those making the charge. The phrase "skilled in the art" is always a relative one. When a patent is adjudged infringed, the question of damages arises, and as yet no clear-cut rules have been made by the Courts. It has been held that the requirements that patented articles shall be so marked is not applicable to a process. G. S.

119. The Recovery of Tin from Waste Scrap.—*Chem. Age*, Feb. 5, 1927.

For the Chlorine processes, it is claimed that detinning can be carried out in larger units and at lower labour charges than in the other existing processes, practically the whole running cost being repaid by the sale of the recovered iron billets.

In the Goldschmidt process, the dried tin scrap is treated with chlorine gas under 7·6 atmospheres pressure at 25° C., the heat of reaction being dissipated by external cooling. The end of the reaction is marked by the fall in pressure to a constant level.

A dry mixture of chlorine and a gas, such as air, is drawn by suction through the scrap, in the Von Schutz process. Arrangement is made for preheating the inflowing gases.

In processes such as that of Dubois and Kaufmann, carbon tetrachloride is used as a solvent, and the tin salts together with the solvent may be recovered by subsequent treatment with steam.

In all these processes the tin is recovered as marketable stannic chloride. A. R. S.

120. The Economic Position of Fuel Oil.—Campbell Osborn and Chas. J. Deegan. *Oil Trade*, March, 1927, XVIII., 3, pp. 19–20, 55–57.

During 1926, the yield of gasoline, including blends, from crude oil amounted to 37·3 per cent., kerosene 8 per cent., lubricants, 4·2 per cent., and fuel oil 46·6 per cent.

In its engineering sense, "fuel oil" includes gas oil, residual fuel oil, and low-grade crude oil. Gas oil and residual fuel oil represent the major part of the total, and from these the raw material for cracking is drawn chiefly. The decreasing refinery yields of fuel oil due to cracking, and the increasing yield of gasoline are shown by a graph. Apart from cracking, fuel oil has wide uses and the trend of these is shown by a graph. A graph is also given, showing the general rising trend of fuel oil prices.

The average spot price for Mid-Continent fuel oil during 1924–1926 was 2·6 cents per gallon. On the basis of 5 cents per gallon for manufacturing cracked gasoline, the average cost of Mid-Continent cracked gasoline was 7·6

cents per gallon. The proportion of gasoline made at this cost in 1924 was 25 per cent., and in 1926, 31 per cent.

In 1922, the difference between gasoline and fuel oil prices was 12 cents, and in recent years this has been reduced to from 6·75 to 8 cents per gallon. As cracking expands, this will be further reduced until nearly all the fuel oil competing with coal has been absorbed.

It has been said that when the gasoline yield reaches 42·5 per cent. the inefficient yield of fuel oil will be a thing of the past, and gasoline prices will rise. This necessarily assumes no further increase in crude production. The authors disagree with this, and consider that the period will not be reached until the gasoline yield is 46·4 per cent., which at present rates would be reached in about 1930.

The price of gasoline, and therefore of other products, is largely controlled by the price of fuel oil made in refining processes. Another factor which affects the price of fuel oil, and indirectly the price of gasoline, is the low-grade crude oil used directly for fuel.

The conclusions drawn are: (1) The yield of gasoline will continue to increase during the next four years at about 2 per cent. per annum. (2) Fuel oil recovery will continue to decline. (3) Raw material for lubricating oils is considerably in excess of demands. (4) Kerosene yield will remain comparatively level for the next five years. (5) If crude oil prices rise, fuel oil consumption may decline. (6) The marine use of fuel oil will expand in motor ships and efficient steam ships. With higher prices the railroad use of fuel oil will decrease. (7) The margin between gasoline and fuel prices will diminish. (8) With rising crude prices, low-grade crude now used as fuel will be used for refining. (9) Gasoline, fuel oil and crude oil prices will vary according to the quantity of crude used as fuel. (10) The law of supply and demand is operating and will bring about naturally the conservation so much desired.

G. S.

121. Recent Oil Developments in Colombia. Oliver B. Hopkins. *Petr. Times*, 1927, XVII., 427, pp. 521–522.

Since 1921, when a small refinery at Barranca Bermeja was completed small quantities of oil have been produced, but since the completion of the pipe-line to the coast in May, 1926, Colombia has become a small but important factor in the world's petroleum markets. The production since 1921 has been as follows:—

Year.	Bbls.	Year.	Bbls.
1921	66,480	1924	444,743
1922	323,598	1925	1,006,707
1923	424,876	1926	6,443,540

and the estimated production for 1927 is 14,500,000 bbls.

Oil indications are found in four general areas: (1) the Coastal Area, extending from Santa Maria Mountains to the Panama frontier and inland for 50 to 125 miles. About 25 wells have been drilled without developing commercial production. (2) The Magdalena Valley, extending from near El Banco to beyond Neiva. Commercial production has been obtained. (3) The Catatumbo area, forming part of the Maracaibo Basin. The Barco concession is in this area. (4) The Oriental area, comprising part of the Orinoco and Amazon valleys. No development has been undertaken in this area.

In the Coastal Area, where the rocks are mostly Tertiary of Eocene to Miocene age, small showings of oil are found in widely scattered areas. At Las Perdices, nine wells have been drilled to depths of from 680 to 3030 feet. Near Usiacuri attempts to drill a deep test failed to get below 1770 feet.

At Carmen, two wells have been drilled, one being abandoned at 4330 feet, and the other being in casing trouble at 3677 feet. At San Jacinto, a well abandoned at 4630 feet showed oil and gas at 756 feet, and a second well, now at 3657 feet had large flows of water at 2860 and 3645 feet. At San Andres, two wells have been abandoned at 3812 and 3447 feet respectively, the former showing oil at 600 and 800 feet, and the latter at 3100 feet. Lorencito No. 1, 25 miles from Monteria, reached a depth of 2800 feet with only small shows of gas, and No. 2 encountered large flows of water and a little gas before being abandoned at 2214 feet.

The De Mares concession, the only producing property, is about midway in the Magdalena Valley. The Tropical Oil Co. concession covers about 1,500,000 acres. To the end of 1925, seventy-nine wells had been drilled, 10 of which were dry or lost, and during 1926, 74 wells were completed, of which 72 were producers. On December 31, 1926, there were 141 producing wells, with an average initial production of over 1000 barrels.

In the Catatumbo area, the Barco concession has recently been cancelled, but its reinstatement under favourable terms is expected shortly.

In the Oriental region, several of the larger companies have had geological parties out, but as far as is known only one company has acquired holdings.

The 300-mile pipe-line from Cartagena to the Infantas field was completed in May, 1926, and the first tanker was loaded early in July. Looping of the line has been started and when completed will increase its daily capacity from 30,000 to 50,000 barrels. G. S.

See also Abstracts Nos. 135, 206 and 264.

Chemistry of Petroleum.

122. Some Reactions of Lead Tetraethyl. Browne and Reid, J.A.C.S., 49, III. 830.

A summary of the work already accomplished on the subject is first given, and then follow the preparations of salts of triethyl lead and some of their reactions. In general, salts of inorganic acids are most readily prepared by double decomposition of triethyl lead acetate and the sodium salt of the appropriate acid in aqueous solution. The salts of the organic acids are more generally soluble in water, and it was found preferable to prepare these directly from tetraethyl lead and the desired acid, using silica gel catalyst. In these compounds it was found best to estimate the lead according to the method of Treadwell-Hall. A. R. S.

123. Obtaining Alcohols from Petroleum. C. P. Harris. *Oil and Gas Journal*. Jan. 27th, 1927.

The article reviews the general formation of hydroxy compounds from the hydrocarbons of both natural and still gases. Chief amongst these is isopropyl alcohol. The gases are passed first over a desulphurizer such as copper oxide, and then up the sulphuric acid tower. 97 per cent. acid is used at a low temperature, so that the ethylene passes on unchanged. The acid containing the alkyl hydrogen sulphates is run into water and steam distilled. The crude isopropyl alcohol is fractionated once to give 91 per cent. constant boiling mixture, but this product still has a disagreeable onion-like odour. One method of deodorising is to wash with white mineral oil. Many chemical methods have been evolved, but difficulty lies in the fact that isoprophyl alcohol is a very reactive compound. The best method seems to be to fractionally distil with a very efficient column. The alcohol is finally dehydrated with solid caustic soda. A discussion of its uses follows. S. W. C.

124. The Catalytic Preparation of Unsaturated Hydrocarbons from Carbon Monoxide and Hydrogen. Hoover, Dorcas, Langley, and Mickelson. J.A.C.S., Vol. 49, III, 796.

A description of the apparatus used is first given and then follow details of the preparation and purification of the inflowing gas stream and temperature control. Very comprehensive tables containing data concerning 64 catalysts are given.

Using equal volumes of carbon monoxide and hydrogen with a trace of oxygen, passing with a space velocity of 1500–2000 at 100° C., most efficient production of ethylene (1—3 per cent.) was obtained from a nickel-palladium catalyst deposited on granular aluminium or pumice, but the efficiency of the catalyst is reduced by 50 per cent. in 30 hours. The presence of 1 per cent. of oxygen seemed to favour the production of both unsaturated and saturated hydrocarbons, while carbon dioxide and water, in amounts greater than corresponding to 5 mms. pressure, seriously interfered. Copper and cobalt were the only two single substances to catalyse the reaction, and apart from these an interface of two metals is apparently essential. The activity of a catalyst is increased by precipitation on granular particles, particularly aluminium, and those precipitated by sodium or potassium carbonate are most active, possibly due to the presence of minute amounts of these reagents. A. R. S.

125. Solubility of Naphthalene in Certain Aromatic Hydrocarbons. Rhodes and Eisenhauer. *Ind. and Eng. Chem.*, March, 1927.

The aromatic hydrocarbons used as solvents were toluene, xylene, heavy naphtha, coal tar oil from creosote oil, and cresol in admixture with these solvents. The solubility determinations were first made by determining the temperature at which naphthalene separated out from a solution of known concentration, and the results were duplicated with an accuracy of temperature of 0·1° C. by two independent methods.

The curves representing the solubility of naphthalene in toluene, xylene and heavy naphtha between 0—50° C. are roughly parallel, the solubilities decreasing with increasing molecular weight of the solvent. Addition of cresol to heavy coke over solvent naphtha at first increases and then decreases the solubility of naphthalene mixtures containing 10—20 per cent. cresol showing most marked solubility. The explanation offered for the fact that the removal of tar acids increases the limpid point of a creosote oil is merely that the total amount of solvent for naphthalene is thus increased.

A. R. S.

126. Improvements in the Manufacture and Production of Oxygenated Products from Hydrocarbons or Oxidisable Derivatives of Hydrocarbons. W. A. Caspari. E.P. 262,201. Dec. 30th, 1926.

A colloidal solution or suspension of the catalyst, an oxide of a metal of the 5th, 6th or higher group, in the hydrocarbon in the liquid state is first prepared. A spray of this solution in which air and atomised liquid are present in suitable proportions is passed through a heating chamber raised to 200° C. to 500° C. where oxidation takes place. S. W. C.

127. Improvements in the Preparation of Alcohols from Olefine-bearing Gases. H. S. Davis, Assr. to Petroleum Chemical Corp., U.S. E.P. 240,834. Jan. 13th, 1927.

Gases of high propylene content are used. These are first freed from hydrogen sulphide and are then passed through two absorption towers down which flows 80 per cent. H_2SO_4. This serves to remove the more reactive

olefines and also the water vapour. They then pass through four absorption towers down which flows 100 per cent. H_2SO_4, and here the propylene is absorbed. The towers are cooled by water flowing down the outside, and the temperature of the 100 per cent. H_2SO_4 towers should not exceed 30° C. The acid enters at the last tower, and after flowing countercurrent to the gas to the base of the first tower, is run off into a tank, diluted with water, and the diluted mixture run into a still and steam distilled, the constant boiling mixture of isopropyl alcohol and water being collected. The towers are 24 ft. high and 6 inches in diameter, the rate of flow of gas being 10 c. ft. per minute, and of acid 2 to 3 gallons per minute, for a gas containing 10–15 per cent. of propylene.

S. W. C.

See also Abstracts Nos. 140, 142 and 160.

Natural Gas.

128. Cooling of Absorption Oil at Gasoline Plants. E. R. Cox. *The Refiner*, Feb., 1927.

The paper draws a comparison between two types of cooling plants: (1) Tubular coolers, in which the water is circulated through the tubes and the oil in counterflow through the shell space, and (2) Circulation of the oil in a pipe coil located in a cooling tower or spray pond. The results of numerous experiments are given, and it is shown that the second method holds all the advantages, being lower in cost, attaining lower temperatures, and giving less trouble from scaling.

S. W. C.

129. Recovery of Sulphur from Gas. K. N. Cundall. *Chem. and Met. Engineering*, March, 1927.

The original method of liquid purification as developed by the Koppers Co. forms the basis for the new process. The odourless removal of H_2S from the soda solution was finally accomplished by chemical conversion with SO_2 in the presence of a catalyst. It was finally found that SO_2 was unnecessary, the catalyst accelerating the oxidation in the presence of oxygen alone. The most active catalyst found was colloidal nickel sulphide, formed by the addition of nickel sulphate to the solution.

The soda solution in contact with the gas in the absorber, picks up H_2S to form the hydrosulphide and sodium bicarbonate.

$$Na_2CO_3+H_2S=NaHCO_3+NaHS.$$

This solution passes to the activator, where, along with the catalyst and air, the following reaction takes place :—

$$NaHCO_3+NaHS+\tfrac{1}{2}O_2=S+Na_2CO_3+H_2O.$$

Thoroughness and time of contact are conditions which must be maintained. Sodium thiosulphate and sulphocyanate are two compounds formed which accumulate in the solution. The catalyst becomes poisoned by the HCN present in the gas, sodium nickel-cyanide being formed.

Three types of activators were developed and are in use.

(1) The Thionizer type supplies air to the solution by means of canvas covered perforated pipes placed at the bottom of a series of compartments through which the foul solution flows in a zigzag path.

(2) The Sirocc emulsifier is a superimposed set of 4 tanks, each fitted with a turbine driven, basket type impeller. This device supplies its own air through the sucking action of the whirling blades around the periphery of the wheel. The solution flows in series through the 4 emulsifiers. Its ability to produce free sulphur is equally as good as the thionizer.

(3) The Feld type emulsifier resembles the Sirocco device more than the Thioniser. It consists of a vertical cone having a 5° taper which rotates in a tank at a speed of 89 r.p.m. The cone at the top is fitted with 2 sets of protruding teeth, 6 in. apart. These come within 2 in. of the vertical ring of teeth on the bottom of the air chamber. Air is forced into this chamber and out through the whirling sets of teeth. The action of the cone is to pump the air and solution up through the centre and force it through the slot between the teeth.

The separation of the sulphur from the solution is easily accomplished as it forms a grey muddy foam which tends to float on the surface. The solution from the activator is passed into a tank where, by means of baffles, the solution flows off at the bottom into a tank on one side, while the sulphur foam is spilled over an adjustable knife-edged weir into a tank on the other side. This sulphur sludge is then pumped to the filter until a cake about 1½ in. has been deposited, when wash water is admitted and the cake thoroughly washed, after which air is admitted and the cake dried to about 50 per cent. water. The sulphur is then removed from the filter and is ready for disposal.

S. W. C.

130. Compressed Gas Handling Technique. F. A. Ernst. *Chemical Eng.*, March, 1927.

New designs in joints, valves, heads for pressure vessels, means of inserting electric conductors and packing are described and illustrated. These are all claimed to have advantages over the old standard types when handling gases at high pressures. The advantage of using alloy steel as opposed to ordinary carbon steel on account of its extra strength is also discussed. P. D.

131. California Absorption Plant takes Small Ground Space. G. Reid. *The Refiner*, Feb., 1927.

Natural gas at 5 lb. pressure is boosted to 35 lb. pressure. The gas is first scrubbed and after being cooled in the cooling tower is again scrubbed before entering the absorbers and is given a final scrubbing on leaving the absorbers. Campbell oil froth absorbers are used. Rich oil leaving the absorbers passes counter-current to hot lean oil leaving the stripper in the standard Campbell heat interchanger. On leaving the interchanger the warm enriched oil passes through steam preheaters into the stripper. The lean oil leaving the interchanger is cooled and returned to the absorbers. The vapours from the stripper are passed through a partial condenser where the temperature is reduced sufficiently to condense the steam and all the heavy particles of the gasoline vapours. This condensate is run off, separated, and the heavy ends returned to the absorber, the whole thing being automatically controlled. The plant has a daily production of 17,000 gallons of gasoline. S. W. C.

132. Process for Separating a Mixture of a Large Number of Volatile Liquid and Gaseous Hydrocarbons.—De Bataafsche Petroleum Maatschappij and J. H. C. De Brey. E.P. 255,428, Feb. 17, 1927.

The volatile liquid and gaseous hydrocarbons are of the nature of casing-head gasoline. The components are separated by subjecting the mixture to distillation under pressure in at least two subsequent rectifying columns so as to obtain at least three different fractions. The patent also claims the method of making substantially pure hydrocarbons by this method and blending of the stabilised gasoline produced, to produce commercial gasoline.

A. R. S.

133. Improved Process for Continuously Separating a Gaseous Mixture. N. V. Phillips' Glocilampenfabricken. E.P. 266,396, Feb. 23, 1927.

The patent claims a process for continuously separating a gaseous mixture by diffusion, by causing the mixture to pass into one of a series of separating elements, each of which is capable of bringing about a separation into two fractions, and then supplying the fractions obtained to at least one separation element on each side. A. R. S.

134. Vapour Recovery. C. L. Voress and N. C. Turner. U.S.P. 1,616,242.

In recovering liquid hydrocarbons from vapour by adsorbing with activated charcoal the yield is poor in quantity and quality if there is only a small portion of the vapour recoverable. In order to surmount this difficulty the hydrocarbons are recovered in two stages. In the first the charcoal is allowed to adsorb up to 3 per cent. of its weight, and the current of gas is stopped. The hydrocarbons are steam-distilled off the charcoal, and the vapour after cooling (now rich in recoverable material) is passed over a second quantity of charcoal. P. D.

See also Abstract No. 138.

Motor Spirit.

135. Meaning of Specifications for Gasoline, Etc. Kraemer. *Pet. Times*, Feb. 5th, 1927.

A short survey of the development of the U.S. standardization of petroleum products is given, followed by a table of the changes in specification for gasoline from 1918–24. The adoption of the tests is discussed from the viewpoint of average production of gasoline in America, as determined by the semi-annual surveys by the Bureau of Mines. A. R. S.

136. A Laboratory Method of Determining the Starting Properties of Motor Fuels. W. G. Lovell, J. D. Coleman, and T. A. Boyd. *Ind. & Eng. Chem.*, March, 1927, 389–394.

A fuel that will give easy starting in an engine is one which when mixed with air evaporates so completely that only a little of it is required to yield an explosive mixture. In order to estimate the ease of starting given by a fuel the authors used a cylindrical bomb, about 300 c.c. capacity, containing a fan driven by a motor; small receptacles for the charge of fuel were attached to the fan shaft and rotated at fan speed. The bath was brought to the desired temperature in a thermostat, a charge of gasoline was placed in the cups by means of a delivery pipette, the fan was rotated for 2 mins. at 2,200 r.p.m.; it was then stopped and a continuous stream of sparks was passed across the terminals of a sparking plug located in the lid of the bomb. With rich mixtures explosions occurred at once, with leaner ones 3 or 4 seconds elapsed before explosion; a sharp point was reached when further leaning down of the mixture by 1 or 2 per cent. increased the time for ignition by 10 or 20 secs. This point was taken as the limiting mixture. If no explosion occurred the bomb was carefully dried out. This procedure gave results checking to within less than 3 per cent. With pure pentane the explosive limit in another apparatus was found to be a fuel air ratio of 26·2 : 1; with this apparatus it was 23·2 : 1. Various gasolines were tested, a benzol blend at 20° C. formed an explosive mixture at an air fuel ratio of 14·4 : 1, and a gasoline with a much lower volatility by the distillation curve required an air fuel ratio of 2·6 : 1. Benzol blends were found to be very bad for starting

below −5° C. Carefully controlled tests on an engine with the fuels checked very satisfactorily with the bomb results. No direct relationship could be established between the dew point of a fuel, as determined by various workers, and its starting characteristics as determined by the author's method. Engler distillation figures were also found to give no reliable information regarding ease of starting; this may be due to differences in distillation curves which cannot be detected in the Engler apparatus. W. N. H.

137. Comparison of Gasolines by Analytical and Engine Tests. D. R. Stevens and S. P. Marley. *Ind. & Eng. Chem.*, Feb., 1927.

The statements of Messrs. Egtoff and Morrell are critically examined regarding the calculation of the highest useful compression ratio of a fuel from a laboratory analysis. Egloff and Morrell state that the aromatic equivalent of a fuel may be calculated assuming the 5 per cent. olefines are equivalent in antiknock effect to 4 per cent. of naphthenes and to 1 per cent. aromatics. The authors used for engine tests a 1250-watt Delco lighting plant with variable magneto setting, compression ratio 5·5 : 1. A modified Midgley's bouncing pin was used for estimation of the severity of the detonation, a long rod is tapped into a very small piston which is held flush with the cylinder wall by a strong spring of variable weight. The long rod transmits the shock of detonation to a small anvil forming the short arm of an indicating lever; the vibrations of the arm are damped by a light spring. When the engine is not detonating only a slight movement of the arm occurs. The greater the detonation the greater is the deflection of the indicator arm.

Four pure hydrocarbons were prepared; normal heptane from Jeffrey pine oleoresin, hexylene from secondary hexyl alcohol passed over reduced tungstic oxide at 400°, methylcyclohexane, and toluene. Four commercial petrols were analysed, and, using the above four pure hydrocarbons synthetic mixtures were made to match as regards analyses of the four petrols. The engine tests of the synthetic mixture in three cases out of the four differed considerably from that of the petrol to which it corresponded by analysis. Using the four pure hydrocarbons again it was found that 2 per cent. of the olefin was equivalent in antiknock effect to 2 per cent. of the naphthene and to 1 per cent. of the aromatic. In all eighteen commercial petrols were examined, and by a method of cross checking with a standard petrol to which benzol or benzene was added in known proportion the knock characteristics of each fuel were determined and matched by suitably doping the standard petrol. About half the fuels give knock characteristics which agree fairly well with those calculated from analysis, the 2·2 : 1 ratio for the equivalence of olefin, naphthene and aromatic giving slightly better concordance with engine tests than the 5·4 : 1 ratio. The calculated value for the remainder of the fuels differed widely from that experimentally found. The authors conclude that actual engine test is at present the only reliable test for the knock characteristic of a fuel. W. N. H.

138. Treatment of Gasoline. M. W. Harriger and W. S. Baker. U.S.P. 1,619,206. March 1st, 1927.

The invention claims a process whereby all the wild gas (that which causes vapour tension) is extracted from casing-head gasoline. Gasoline is passed through a plurality of parallel pipes located in vertically spaced relation to each other and each sloping downwardly from the horizontal at a small angle. There are a plurality of headers, each having a considerably greater internal diameter than the sum of the internal diameters of the pipes, the first header being connected with all of the pipes at one end and the last header being connected with all of the pipes at the other end, while all of the pipes open into

each intermediate header. The whole arrangement is situated within a tank supplied with water at 114° F., so that the gasoline is maintained at 100° F. The gasoline enters the first header, and as it flows through the tubes and headers, the gas escaping in the headers passes up into a tank, and the gasoline can be withdrawn at any of the last three headers as required. The gas tank is provided with a bottom outlet so that any gasoline carried up with the gas is returned to the first header, and the gas passes out through a flow line from which it can be used or sold as natural gas. It is claimed that this plant will extract all of the wild gasoline having a vapour tension as high as 28 lb. per sq. inch. S. W. C.

139. Improvements in Apparatus for Filtering Liquid Fuel. H. E. Pelletier. E.P. 265,848.

This invention relates to liquid fuel purifiers and particularly to the type adapted to be inserted in the gasoline feed line of an internal-combustion engine. The filter removes from the fuel not only foreign solid particles, but also foreign liquids such as water, acid, etc., before the fuel is fed to the carburettor. The fuel is led into the bottom of the filter by way of an inlet pipe, and is caused to strike the bottom of the inside container, thereby being dispersed through a filtering liquid. This filtering liquid must have a specific gravity higher than that of the fuel, and in some cases a low freezing-point. In addition, a screen of fine wire cloth is provided which serves the double purpose of keeping out both the filtering liquid and any solid particles which might rise to the surface of the filtering liquid or which might be carried in the fuel. W. H. T.

See also Abstracts Nos. 128, 131, 132, 171, 205, and those under the heading of "Anti-detonation."

Kerosine.

140. The Desulphurizing Efficiency of Silica Gel. H. I. Waterman and M. J. van Tussenbrock. *Brennstoff-Chimie*, Jan. 15, 1927.

Mixtures of ethyl sulphide and kerosine of known sulphur content were used in the determinations, and the silica gel was prepared from technical "Waterglass" by air, first partially drying and then activating the product by heating at 225—250° in a current of fresh air for 1½ hours. The gel was then graded in size before use. The treatment consisted in shaking 30 gms. of spirit with 2 gms. silica gel for 3 hours and estimating the sulphur content both before and after, by burning a known quantity and causing the products of combustion to pass through 3 per cent. hydrogen peroxide. The sulphuric acid was then estimated by titration using methyl red indicator. The conclusions drawn are that the coarser particles are less efficient desulphurizing agents, but that the efficiency is not increased by decrease in particle size beyond certain limits. Increase of water content also decreased the efficiency of the gel. A. R. S.

141. Methods of Refining Hydrocarbons. O. D. Lucas and E. L. Lomax. U.S.P. 1,615,286, Jan. 25, 1927.

In the usual refining practice light hydrocarbons are treated with concentrated sulphuric acid to remove polymerised bodies. This method removes unsaturated compounds whose presence in a motor-fuel is desirable.

In this patent a method is described in which the crude distillate is washed with chamber sulphuric acid (65 per cent. strength) and alkali to remove basic and acidic bodies, after which it is heated in a pipe still under pressure

to a temperature 10—20° C. above the b.p. of the highest boiling constituent. The vapours are then allowed to expand into a filter filled with bauxite or other suitable substance. A rapid stream of inert gas is forced into the filter through the same inlet pipe as the vapours in order to facilitate passage of the vapours through the filtering medium to the condensers.

P. D.

Lubricating Oil and Wax.

142. Deterioration of Mineral Oils. I. Mechanism of Oxidation and the Action of Negative Catalysts as determined by a Dynamic Method. Haslam and Frölich. *Ind. and Eng. Chem.*, Feb., 1927.

The oil used throughout was a highly-refined oil, and oxidation was accomplished by heating at constant temperature in a current of oxygen. The extent of oxidation was measured by increase of either acidity or viscosity. At the temperature of the test it was found that the presence of moisture had no bearing on the result, while the oxidation ratio with any gas mixture was proportional to the partial pressure of oxygen. However, the susceptibility to oxidation is increased by preheating even in an atmosphere of nitrogen.

The effect of catalysts on the oxidation rate was investigated and it was found that some substances acted as positive and others as negative oxidation catalysts, while in any mixture containing catalysts of both types, the oxidation rate was intermediate between the rates for those concentrations of the individual catalysts.

The mechanism of the oxidation is explained by the presumption that the hydrocarbons oxidise primarily to alcohols, then to aldehydes or ketones, which in turn either oxidise with great relative rapidity to naphthenic or fatty acids, or polymerise to asphaltic bodies. Catalysts of the negative type are merely efficient in prohibiting the formation of alcohols. This last assumption is shown to be justified by the fact that no oxygen is taken up as long as the catalyst remains in its original form.

A. R. S.

143. Iso-Vis: The New Oil Lubricants. *Petroleum Times*, Feb. 5, 1927.

It has been ascertained that average lubricating oil running in an automobile engine takes up about 16 per cent. of diluent from the fuel, thus losing fully two-thirds of its initial viscosity. The Iso-Vis oils are prepared so that the refining increases the vapour pressure of the heavy oil to correspond with that of a used oil, and thus a crank case dilution of more than a small percentage is avoided. This primary advantage of practically constant viscosity in operation is increased by the fact that the temperature coefficient of viscosity is relatively small.

A. R. S.

144. Factors in Reclaiming Crank-case Oil. H. L. Kauffman. *The Oil and Gas Journal*, Feb. 3, 1927.

In this paper the author discusses the possibility of marketing reclaimed lubricating oil. The gasoline content of such oil has in the past been a serious drawback, but as the Standard Oil Co. are now marketing a diluted oil this prejudice should be overcome. The author shows that reclaimed oil is quite suitable for use in automobiles and considers the prospects of this industry to be good.

K. B. R.

145. Design and Operation of a Contact Filter Plant. H. L. Kauffman. *Chem. and Met. Eng.*, 34, 3, p. 155.

The article describes the contact filtering plant built at the Parco, Wyoming, refinery which has now been in operation since December, 1924. Briefly,

the process involves the mixing, with the aid of heat, of finely-divided and highly adsorptive filtering materials with the oil to be purified, and thereafter separating the spent adsorbent from the purified oil by suitable mechanical means. The filtering material is an acid-treated clay of the bentonite type, this being applied to the untreated oil in the form of a clay pulp, containing from 25–30 per cent. of solids.

Untreated long residuum or steam refined cylinder stock is pumped from storage to an agitator. Here it is treated with 66° acid, using from 40–45 pounds of acid per barrel of oil. The sludge is allowed to settle and is afterwards removed by being drawn off into dump-cars. The treating temperature is as low as possible—from 140°—150° F.

The acid-treated oil is then removed to a steel mixing agitator, 7 ft. 6 in. by 17 ft. 9 in., fitted with a special type of cyclone mixer, where it is mixed with the clay pulp (½lb. of clay per gallon of oil) and the clay-oil mixture raised by means of steam coils, to a temperature of 180° F. The clay and oil are then heated in a Foster pipe still for about eight hours, during which time the water has been driven off from the clay, and a final temperature of 450° F. has been attained. Suction is applied to the vapour separator, and the clay oil mixture is pumped through two No. 12 Sweetland filters. These filters are 37 in. inside diameter by 145 in. long, and each is equipped with 36 Monel metal, cloth covered, bottom drainage type of interchangeable filter frames. Arrangements are made for passing naphtha through the filter after as much oil as possible has been blown out of the spent cake—this being done in order to keep oil losses at a minimum. A Braun condenser is also installed for reducing naphtha losses. The next operating step consists in diluting the treated oil with naphtha, in the proportion of 30 per cent. of the former with 70 per cent. of the latter. The naphtha oil blend is then chilled to 20° F. and passed through a Sharples centrifuge in order to remove a large percentage of the wax. The partly de-waxed oil is next cooled to –15° F., after which it is again centrifuged, and then has a pour test of 30° F. The refined and wax-free oil is lastly pumped to a reducing still, where the naphtha is recovered, and thence to storage. W. H. T.

146. Methods of Recovering Crank-case Oil. H. L. Kauffman. *Oil and Gas Journal*, Feb. 10, 1927.

This paper contains descriptions of several processes in use for the recovery of crank-case oil. The Alten reclaimer, which is suitable for use on a small scale, subjects the oil to a straining, distilling and filtering process. The light impurities are removed by these means, but the recovered oil is inferior to that reclaimed by a process involving sulphuric acid treatment. The De La Vergne process involves the use of a washing powder with subsequent steaming to remove light fractions. The washing powder tends to emulsify certain types of oil. The apparatus for a similar process, the Miller, is given in detail.

In the General Electric method the oil is first clarified by the use of sodium silicate or a "dope" consisting of a mixture of acid manganese resinate and stearic acid. In order to remove the light fractions the oil is passed in a thin layer over electrically-heated plates. The process is continuous and the plant is designed for small scale work, but several units may easily be joined in order to increase the through-put of oil.

The De Laval process equipment consists of a receiving and treating tank, a centrifugal purifier, a pump for circulating and mixing, and a distilling unit. The oil is treated in the receiving tank with hot sodium phosphate solution.

Apparatus for removing water and breaking emulsions in steamship oils is also described. The process gives oil which may be re-used without further treatment, and the loss of oil during the operation is small.

In another process, after steaming to remove light fractions, all further impurities are removed by centrifuging.

Various facts are also given showing the present disposition of used oils (in America) and an estimation of the quantity of oil wasted yearly. P.D.

147. Manufacture of Refined Oils. E. B. Cobb. U.S. P. 1,616,352 and 1,616,353.

A process is patented for removing sulpho-compounds and emulsion-forming compounds from sulphuric-acid-treated oils. It consists of keeping the oil at a temperature between 350 and 500° F. for a period. The temperature should preferably be 380° F, and the duration of the treatment 20 hours. Steam may be passed through the oil during this treatment. After heating the oil may be washed with an acid solution and filtered.

Before the heat treatment the sour oil may be neutralised with an alkaline solution and distilled to 10–20 per cent. bottom, the subsequent heat treatment being carried out as before. P. D.

148. An Improved Process for the Manufacture of Highly-Viscous Lubricating Oils. Georg Schicht Aktiengesellschaft. E.P. 250,947, March 3, 1927.

A process is described in which highly viscous lubricating oils are manufactured from drying oils. These oils are polymerised by heating to 300° C. in an atmosphere practically free from oxygen, or oxidising agents. Mineral oil is added to the drying oil at the commencement of heating, and the heating is continued until the majority of the unsaturated fatty acids (with two or more double bonds) have disappeared from the oil. The heating is discontinued before the thickened oils have lost their solubility in mineral oils. W. H. T.

149. Process of Producing Lubricating Oils. G. A. Kramer. U.S.P. 1,619,348, March 1, 1927.

In this patent a process is described by means of which oil is distilled *in vacuo* to produce lubricating oil. Steam is passed through the oil in the still, a decrease in the partial pressure of the hydrocarbons being produced by this means.

The vapours are passed to a lubricating oil condenser the temperature of which is carefully regulated by means of an air-blast. The lubricating oil is condensed here uncontaminated by the small quantities of cracked products produced in the still. The vapours then pass to a condenser for cracked products and finally to a spray condenser to condense the steam.

The vacuum is obtained by means of a pump placed after the spray condenser, and a steam injector placed after the oil condenser.

It is recommended that oil with a boiling range above 600° F. should be used. In the apparatus the lubricating oil is obtained by heating the still to about 300° F. A temperature drop of 10° to 50° F. is arranged in the lubricating oil condenser. P. D.

150. Improved Method of and Apparatus for Distilling Mineral Oils, Tar and the like. R. Neumann and Leo Steinschneider. Brit. Pat. 257,257, Feb. 24, 1927.

The liquid is distilled under high vacuum, by heating the liquid at some point in the system, so that the liquid is constantly circulating, but evaporation is delayed until the liquid is in a shallow tray contained in the high vacuum vessel. The evaporation may take place in a series of these vessels arranged in cascade formation. A. R. S.

151. The Separation of Paraffin Scale from Crude Paraffin Wax. E. Bolani. *Petroleum*, 1926, 22, 1347–1349.

For the quantitative valuation of the wax in the crude wax mass a small crucible of fireclay, thoroughly porous, glazed on its sides but unglazed on the bottom is used. This is inverted on a cork, in which a glass tube communicates with a suction bottle. By the use of gelatine a suitable moulded space is formed on the bottom of the crucible, and this is filled with a weighed amount of crude wax mass, and the whole apparatus weighed. Then by suction the adherent oil is drawn into the bottle through the porous base of the crucible, and, the oil being emptied out of the bottle, the apparatus is weighed. The remainder of the weight indicates the wax content of the mass to 1/10 of 1 per cent. H. M.

152. Avoiding Shock Chill in Chilling and Separating Substances. H. A. Gill, comm. by Sharples Speciality Co. E.P. 261,450, July 20, 1925.

For separating wax from petroleum products or stearine from vegetable oils, the liquid is gradually cooled, as by circulating brine coils from an ammonia refrigerating plant, so that the refrigerant never differs in temperature from the liquid by more than a small fraction of the total range through which the liquid is cooled. The wax is separated as a discontinuous precipitate on cooling, and its subsidence is prevented by agitation. In this form it is in a more coarsely divided state than when shock chilled, contains less occluded oil, and is easily separated by centrifuging. The temperature of the brine in the circulating pipes is adjusted by small additions of colder brine, to maintain a temperature difference of about 5° F. between the cooling medium and the oil. H. M.

153. Process and Apparatus for Removing Wax from Oil. S. H. Hall. U.S.P. 1,616,041. Feb. 1, 1927.

The invention relates to the known process of separating wax from waxy mineral oil, in which the oil is diluted with light spirit, and the mixture chilled, after which the wax is removed by centrifuge. The object of the invention is to conserve the diluent, and provide a continuous process for what is now a partially intermittent one. Waxy mineral oil and a heated diluent are mixed together and made to pass through successive mixing, blending, cooling and chilling apparatus. Heat exchangers are provided whereby most of the heat from the diluent is conserved and returned to the mixers. A certain quantity of cooled mixture is maintained, and arrangements are made whereby the rise and fall of the level of cooled mixture intermittently stops and starts the flow from the separate bodies of oil and diluent. W. H. T.

See also Abstracts Nos. 174, 175, 176 and 177.

Special Products.

154. Continuous Clarification of Dry-Cleaning Spirit by Centrifugal Means. *Industrial Chemist*, March, 1927.

In the old process of dry-cleaning the fabrics were given a first wash by agitating in a certain quantity of spirit which remained unchanged during the operation. At the end of the operation all the soluble matter is dissolved and a certain amount of the insoluble matter is held suspended in the used spirit, which is drawn off and distilled in order to clean it. But a certain quantity of insoluble matter becomes deposited over the whole surface of the fabric and this necessitates one, and possibly two, further washes,

the spirit each time having to be distilled. A great saving may be effected by fitting De Laval centrifuges which continuously remove the solid matter. The second and third washes may be dispensed with; and, since during the first wash the whole bath passes through the centrifuge five times, the process is more efficient. The cleaning spirit may be used for more than one wash, as the presence of a small quantity of dissolved matter does not impair its efficiency. The solid matter is deposited in the centrifuge in a compact form and is easily removed. The centrifuges are adaptable to all types of dry-cleaning apparatus. P. D.

155. Reclamation of Dry-Cleaning Spirit (by Use of the Stream Line Filter). *The Industrial Chemist*, Feb., 1927, 67-72.

The spirit used for dry-cleaning textile materials may be cleaned in any of four different ways—namely, by distillation, by sedimentation either gravitational or centrifugal, by coagulation of impurities by adding chemicals, or by filtration. The dirty spirit contains added soap and natural oils extracted from the materials as well as dirt and of these it is desirable only to extract the dirt, as soap is necessary for cleaning and the oils when returned to the clothes remove the "papery" feel often exhibited by dry-cleaned goods. Distillation yields a water-white liquid which may or may not be sweet-smelling. The residue contains soap, fatty matter and dirt and is difficult to dispose of.

Sedimentation removes the dirt to a greater or less extent, depending on the time factor, but involves a large stock of spirit if carried out by gravitational methods and frequent stoppage of a centrifugal machine for cleaning. The cleaned spirit is often not quite free from suspended matter.

Coagulation of the soap content by adding caustic soda removes both soap and dirt, and by the use of decolorising carbon a sweet and colourless product is obtained. Another process uses a sulphonated oil and produces rapid settling, but in both these cases the sludge is difficult to dispose of and any excess reagent added may remain in the spirit with disastrous results.

Filtration appears to solve the problem, as the dirt only may be removed and this dirt converted to a dry form which is readily disposed of.

A plant using a battery of Stream-Line Filters is described. The filter consists of a number of special paper rings threaded on to a square rod and compressed by means of a spring. The dirty spirit is forced between the discs and deposits its dirt at the outside edge, the filtrate escaping along the flats of the square rod.

The plant described is capable of filtering from 2,000 to 7,000 gallons per day. A battery of Stream-Line Filters in a single container are fed with dirty spirit by means of a steam pump. The spirit is heated first in a heat exchanger by the filtrate and then by steam coils up to a temperature of 70°—80° C. The filtrate is cooled first in the heat exchanger and then by water and passes out of the plant through a meter.

The filters are cleaned hourly by compressed gas, such as carbon dioxide or air and the cleaning operation takes 5—6 minutes. Suitable valves allow the cleaning to be performed without any opening up of the plant. The dirt collects in the base of the filter and once a day is blown into a steam-jacketed still fitted with a stirrer to prevent caking of the dirt and to promote uniform heating. The spirit extracted by distillation from the dirt is condensed and recovered, and the dirt is extracted in a dry form.

Loss of spirit in filtration is small, being about 0·1 per cent. of the spirit in use. Filtration at an elevated temperature is rapid and the soluble fats are left in the spirit, only a small distillation being required to keep the concentration of fat at a constant level. E. R. B. S.

156. Special Naphthas with Pipe Still. F. C. Koch. *Oil and Gas Journal*, Mar. 10, 1927.

The article gives a description of an installation at the Medway Oil Co.'s refinery at the Isle of Grain. It stresses the difficulty experienced in building on ground so near the water. Everything had to be raised on piles, and this called for the lightest equipment.

Special naphthas are often made from bubble towers on shell stills but it is unusual to make them from a bubble tower pipe still layout. The charging stock is Russian kerosene and the products are heavy naphtha and white spirit. S. W. C.

157. New and Improved Bitumen Emulsion and Process for its Production. E.P. 263,307, Dec. 30, 1926.

This patent claims the method of preparing emulsions by agitating the melted bitumen in water with "liquid rosin"—a product obtained in the sulphite cellulose wood pulp process, and consisting largely of rosin acids—in presence of caustic alkali. Water may then be added to the emulsion as required. A. R. S.

158. A Process of Working up Acid Resins, Obtained from the Refining of Mineral Oil Derivatives, into Neutral Bitumens. Friedrich Wilhelm. E.P. 254,674, Feb. 17, 1927.

The acid tar is heated to liquid consistency and part of the sulphuric acid settles out and is run out. Heating is continued to 130° C. when either sulphur is added to or sulphuretted hydrogen passed through the mass, thus causing reduction of sulphuric acid to elemental sulphur. The neutral bitumen obtained is claimed to be of good appearance and ductility. A. R. S.

159. Method of Treating Hydrocarbon Oils. L. E. Jackson. U.S.P. 1,619,869, Mar. 8, 1927.

The patent describes a method of purifying spirit or naphtha which has been used for dry-cleaning purposes. After use, the spirit contains varying quantities of fatty acids together with foreign matter in suspension. It is claimed that both these impurities may be removed by adding to the material a quantity of aqueous alkali sufficient to neutralise the fatty acid present, with a margin of excess not exceeding 10 per cent. of the amount required to effect exact neutralisation. The precipitate formed by the addition of alkali settles to the bottom of the container, carrying with it the suspended foreign matter. The resultant sediment can easily be separated from the purified spirit. W. H. T.

See also Abstract No. 164.

Analysis and Testing.

160. The Temperature Effects of Mixing Liquids. W. M. Madgin and H. V. A. Briscoes. *J. Soc. Chem. Ind.* **46**, 12.

A table is given showing the temperature change when 37 organic liquids are mixed in pairs. The experimental method did not permit of a very high order of accuracy. P. D.

161. Notes on Water Analysis. Burton and Haslam. *J. Soc. Chem. Ind.*, March 25th, 1927.

Temporary hardness is estimated on the usual lines, using 200 c.c. of the water in a conical flask and titrating against $\frac{N}{10}$ hydrochloric acid using

bromophenol blue as indicator. A blank determination using the same quantity of distilled water and indicator is carried out, to determine the quantity of acid necessary to change the indicator.

In the determination of permanent hardness 50 c.c. of a solution containing equal quantities of $\frac{N}{10}$ sodium hydroxide and $\frac{N}{10}$ sodium carbonate are added to 200 c.c. of the water which had been previously boiled to expel free carbon dioxide. The whole is boiled down to about 70 c.c. volume, cooled, made up to 100 c.c., settled and then 50 c.c. are filtered off and titrated against $\frac{N}{10}$ hydrochloric acid and methyl orange in the cold.

This method is said to be inexact, due to the action of the alkali hydroxide on the cellulose of the filter paper giving in consequence high results. Repeat determinations, using the same water and conditions were made, only allowing the solution to settle completely and pipetting off an aliquot part of the clear solution. It was found that the error due to filtration was quite negligible using Munktell's No. 1F, 18·5 filter paper, considering that 0·1 c.c. difference in burette reading corresponds to 0·5° hardness.

For waters with high magnesia hardness, the reagent should be made up with 14·5 g. sodium carbonate and 8·01 g. sodium hydroxide per litre.

For magnesium hardness the following is suggested:—Add to 200 c.c. of water the volume of acid determined in the determination of temporary hardness, deducting the figure for the blank, and boil this solution to 70 c.c. volume. To this is now added 100 c.c. of lime water of known strength, and the whole heated to 100° C. on the water-bath, cooled, made up to 200 c.c., shaken and allowed to stand until perfectly clear, when 100 c.c. is pipetted off and titrated with $\frac{N}{10}$ hydrochloric acid and phenolphthalein.

A. R. S.

162. Chemical Control at Treating Plant. L. J. Catlin. *The Refiner*, **6**, No. 2, 57.

Two methods for controlling chemical treatment may be used in refineries either testing the products made or testing the reagents used. The second method gives better control and more complete utilisation of the reagents used.

A knowledge of the reactions occurring during treatment is necessary. Thus, when caustic soda is used for the removal of sulphuretted hydrogen the wash liquor is tested for hydroxide, sulphide and hydrosulphide. It is known that this reaction takes place in two stages, the sulphide and hydrosulphide being the products of each stage respectively. The second stage of this reaction slows up considerably after one-third of the theoretical quantity of hydrosulphide has been formed.

Where caustic soda is being used to neutralise acid from a previous wash or carbon dioxide alkalinity, carbonate and bicarbonate estimations are sufficient.

The function of caustic soda in doctor solution is as a carrier for lead, and therefore in this case tests for alkalinity and lead content give perfect control. The author concludes with directions for making the necessary standard solutions for controlling the above treatments. K. B. R.

163. Methods of Analysis of Coal. Department of Scientific and Industrial Research. Fuel Research.

This report is substantially the same as the Interim Report on the same subject published in October, 1923.

It embraces in seven sections the proximate and ultimate analysis of coal, determination of phosphorus in ash, caking index, calorific value, and the Gray King and Lessing carbonisation assays of coal.

The eighth section details, with tables, the method adopted of reporting analyses, while in two appendices are given the method of determination of carbon dioxide in coal and abnormalities likely to be met with in the determination of phosphorus. A. R. S.

164. Pitch Softening Points. R. G. W. Eadie. *J. Soc. Chem. Ind.* **46**, 12, 109 T.

It is stated that the Kraemer and Sarnow method of determining the softening point of pitch is liable to give inconsistent results, and is too elaborate for rapid testing. The ring and ball method gives good results, but presents difficulty with brittle vertical retort tar pitches. A new method called the "double screw" method is described, which has certain advantages over the other methods, and gives concordant results.

A $\frac{1}{2}$ in. length of steam pipe is turned with a $\frac{1}{2}$ in. gas tapping, and for the inside of this ring a $\frac{1}{2}$ in. length of $\frac{1}{2}$ in. iron rod is cut and turned with a $\frac{1}{2}$ in. standard Whitworth thread. The plug is screwed for half its length into a hole in a metal plate, and the ring placed on top so as to form a thin annular space as a mould for the pitch. When the mould has cooled thoroughly it is removed from the plate by unscrewing, and the top surface levelled off with a warm knife. In order to carry out the test the mould is suspended horizontally in a beaker of water with the plug projecting downwards. The lower surface of the pitch should be 1 in. above the bottom of the beaker, and the upper surface 2 in. below the surface of the water. A thermometer is arranged in such a position that the bottom of the bulb is on a level with the bottom surface of the mould. Heat is applied to the beaker so that its contents rise in temperature at a rate of 5° C. per minute. The softening point is the temperature recorded when the plug, slipping from the ring, reaches the bottom of the beaker. The results obtained with the apparatus for the same samples of pitch are stated to agree to within 1° C. W. H. T.

165. Controllable Variables in the Quantitative Study of the Submerged Corrosion of Metals. Fraser, Ackerman and Sands. *Ind. Eng. Chem.*, March, 1927.

The great influence of controllable variables on the results of laboratory corrosion tests of the total immersion type is discussed and illustrated by data obtained in a study of the action of various concentrations of sulphuric acid on Monel metal.

Three types of apparatus are described: (1) Where the test pieces are supported in glass stirrups, which are actuated so that the pieces travel at constant speed in a circular path, and are set at an angle to the plane of their orbits. The speed is controlled at 60 ft. per min. and air and oxygen or other gas is introduced into the corrosive liquid through porous alundum crucibles, the rate of flow being recorded by flowmeters, and the bath temperature being kept constant. (2) Where the pieces rotate in a sealed rectangular sectional vessel by attachment to a central rotating shaft. The speed can be increased up to a maximum of 750 ft. per min. as desired, and gas is introduced as before. (3) Where the liquid flows at constant rate past the stationary test pieces, the rate of liquid flow being recorded by a Venturi meter. Satisfactorily reproducible results have been obtained with all three.

The conclusions arrived at are that the concentrations of dissolved oxygen and of the active ions of the solution, the velocity of relative motion between the test pieces and solution, and the temperature must be closely controlled. Moreover, such changes in rate of corrosion are not always in the same direction because of the concurrent differences in oxygen solubility with changing ionic concentrations. A. R. S.

166. A Simple and Inexpensive Kjeldahl Digestion Apparatus. Hastings, Fred and Peterson. *Ind. Eng. Chem.*, March, 1927.

A lead pipe fitted with side arms bearing loosely fitted lead stoppers, free to move on the outside of the arms, is used, and each side arm has attached to it a flask. Suction along the main pipe and consequently from the flasks is accomplished by closing one end of the main pipe and connecting the other to a modified Bunsen water pump constructed of lead and equipped with a large water trap to absorb acid vapours. A. R. S.

167. Laboratory Fractionating Columns. Hill and Ferris. *Ind. Eng. Chem.*, March, 1927.

The binary mixture used throughout was a mixture of benzene and carbon tetrachloride, and all the commoner forms of laboratory fractionating columns were examined as regards relative efficiencies. In all cases, the columns were thermally insulated after the principle of Peters, and at the top of each column were fitted two diametrically opposed exactly similar reflux condensers, one delivering the condensate to be measured, while the other supplied the reflux to the top of the column, thus controlling the reflux accurately.

The results show that the popular designs of laboratory fractionating columns have lower efficiencies than packed columns of the Hempel type with selected packings, while marked efficiency is shown by a column packed with jack chain. The Lessing ring packing is shown to have special value, in that its flooding rate is much higher than that of any of the others.

A method is described which may serve for an accurate comparison of efficiencies in subsequent work. A. R. S.

168. A New Method of Estimation of Nitrogen in Fuel. G. Lambris. *Brennstoff.-Chem.*, March 1st, 1927.

The errors liable to occur in both the Kjeldahl and Dumas methods are first described, and for the method described it is claimed that any methane formed is completely burned and not collected with the nitrogen.

The principle of the estimation is that of Dumas, and the apparatus consists of a spherical generator for CO_2 and oxygen, combustion tube containing substance to be estimated, a glass vessel connected to two others for absorbing excess CO_2, an explosion pipette in which any methane formed is burned in oxygen, another tube to absorb oxygen and finally the azotometer.

In the special generator CO_2 and O_2 are generated by the interaction of K_2CrO_4 solution, H_2SO_4, H_2O_2 and K_2CO_3 solution. These gases pass into the combustion tube which contains the substance impregnated on asbestos, copper oxide and copper powder. The oxide is kept at a bright red heat, while the metal is kept dull red. From this tube the gases pass into the absorption bottle containing 50 per cent. KOH solution, where the CO_2 is absorbed, the residual gases passing into the combustion pipette, which is tubular, vertical and drawn out at both ends into a fine tube. Inside this vessel is fixed a vertical spiral of platinum which is made to glow by an electrical current. The completely burned gases then pass through

a combustion tube containing copper powder, maintained at a red heat, whereby the excess oxygen is completely removed, and the nitrogen passes to the double azotometer. A. R. S.

169. The Quantitative Estimation of Mixtures of Isomeric Unsaturated Compounds. Part I. A Bromine Addition Method. R. P. Linstead. *J. Chem. Soc.*, 1927, 1., 355.

The principle of the method described is that the composition of a mixture of $\alpha\beta$ (HC—C=CX) and $\rho\gamma$ (C=C—CX) isomerides can be determined by comparing the velocity of addition to halogen with the velocities of the two pure substances.

Pure unsaturated acids were used in solution in either chloroform or carbon tetrachloride, the reaction with bromine proceeding in the dark under thermostatic control. The mixtures of isomerides were prepared either by the action of alkali on the pure acids under varying conditions or by a mixture of the two parent isomerides. It was found that the mixtures of isomerides invariably gave figures for the addition of bromine intermediate between those for the parent isomerides. A. R. S.

170. The Extended Formolite Analysis of Crude Petroleum Oils. A. M. Nastukoff. *Petroleum*, 1926, **22**, 1349-1350.

The great capacity for absorption of the formolite for saturated hydrocarbons is utilised in the further analysis of crude oils. Five c.c. of oil being treated in the usual manner, a first formolite number, F_1, is obtained. The first obtained formolite is freed from absorbed saturated hydrocarbons and wax with petroleum ether, filtered, dried and weighed, giving the second formolite number F_2. The second formolite, treated with chloroform; gives the third number F_3, which may be regarded as the true formolite number. In addition to these a number of calculated values, F_4 to F_7, are made use of. The difference between F_1 and F_2 represents the yield in solar and lubricating oils, the difference F_2—F_3 the resin content, and further differences indicate cyclic unsaturated hydrocarbons, etc. A table gives the respective values for eight Russian and one Pennsylvanian crude oil. H. M.

171. On the Valuation of Commercial Benzine by the "Index Number" of W. Ostwald. E. Kroch. *Petroleum*, 1926, **22**, 1245-1247.

The index number is not a new conception, being represented in American practice by the "average boiling point." It is misleading as an indication of the commercial value of a motor spirit, as is shown by graphs of distillation of various benzines, in which two which possess the same index number are shown to differ widely in quality, and two of very similar quality possess index numbers of 133 and 123 respectively. H. M.

172. An Improved Dynamic Method for Measuring Vapour Pressures. J. N. Pearce and R. D. Snow. *J. Phys. Chem.* **31**, 2.

The improvement on the previous methods which is introduced in this paper is the electrolytic generation of the gas to be passed through the absorbing vessels. In previous determinations by this method errors were introduced in the measurements of the large volume of gas used. These errors are eliminated in the improved method, since the volume of gas and also the number of mols. of oxygen and hydrogen may be obtained by placing a silver coulometer in series with the electrolytic cells used for generating it. A porous cup type of coulometer is used. P. D.

173. Viscosity: its Significance and Measurement in Petroleum Production. Lester C. Uren. *Oil Field Eng.*, Feb., 1927, 2., 23-26, 59-60.

The viscosity of an oil may be defined as that internal friction which resists movement of the fluid particles with respect to each other. It may be measured by "viscometers," which give comparative values based on empirical or arbitrary units of measurement, often expressed in seconds of time. For engineering use, such units must be translated into units of absolute viscosity.

In physical terms, absolute viscosity is that force, expressed in dynes, necessary to move 1 sq. cm. of plane surface with a speed of 1 cm. per sec. relative to a fixed plane surface from which it is separated by a layer of oil 1 cm. thick. In c.g.s. units, the unit of absolute viscosity is the "poise," *i.e.*, 1 dyne sec. per sq. cm. Kinetic viscosity is absolute viscosity in poises, divided by the oil density at temperature of test.

Instead of force units, viscosity may be expressed as a multiple of the viscosity of water or some other liquid, the values obtained being "relative" or "specific" viscosities.

The viscosity of crude oil, as also of its products, is largely influenced by temperature. A graph illustrative of this is given. It is interesting to note that at about 500 to 600° F. all oils have substantially the same viscosity.

The various viscometers are briefly described and a graph given for converting the various readings to kinetic viscosity, and also the formulæ.

Temperature-viscosity graphs form a ready means of converting viscosity values for given temperatures to other temperatures. By constructing such graphs on logarithmic co-ordinates, and expressing viscosity in kinetic units, the graph may be plotted as a straight line if the viscosities at two temperatures are known.

The article concludes with a short bibliography on the subject. G. S.

174. Determination of Paraffin Wax in Crude Wax. L. M. Henderson and S. W. Ferris. *Ind. Eng. Chem.*, Feb., 1927.

The main advantage of this method is that the transference of the sample under test is eliminated by using one special vessel throughout. This vessel is made by sealing a piece of test tube on to the bottom of a Kjeldahl flask and then cutting off a large part of the neck. This vessel is then enclosed in a larger vessel through which heated or chilled air can be blown.

A sample is weighed directly into the flask, which is then placed in the heating jacket, after which the solvent nitrobenzene is added. By introducing heated air into the jacket the temperature of the mixture is raised to 70° C., during which time air is bubbled through it. The temperature is then dropped to 32° C., passing an increased supply of air. The wax separates and floats on the surface at this temperature, and the oil is drawn off by suction. The process is repeated, after which the wax is heated to 135° C. and suction applied till all the solvent evaporates off. The temperature is now raised to 150° C. and the wax is air blown for 15 mins. at this temperature, after which the flask is cooled and weighed. A. R. S.

175. The Specific Gravity of Paraffin Wax. F. J. Morris and L. B. Adkins. *Ind. Eng. Chem.*, Feb., 1927.

Commercial paraffin wax contains occluded air and this greatly affects the determination of its specific gravity. In this paper it is claimed that this difficulty has been overcome by the use of a special hydrometer. This is really a modification of Nicholson's hydrometer, made of glass, in which the

bottom pan consists of a pair of small glass petrie dishes, the inner inverted one having two V notches cut in its sides to allow easy access of liquid. Before test, samples are heated to 140—150° F. under 30 mms. pressure and kept for 24 hours in this condition, after which they are cooled *in vacuo* to room temperature. Carefully cut samples are then weighed on the hydrometer at suitable temperatures. A. R. S.

176. Evaluation of Turbine Oils. Rogers and Miller. *Ind. Eng. Chem.*, February, 1927.

Highly refined turbine oils are subjected to the author's stability test, which consists in passing excess of moist oxygen through a mass of the oil containing a known amount of iron wire. The oil is contained in a round bottomed flask kept at 100° C. by means of a water bath. Periodical samples are removed and subjected to the "Herschel" demulsibility test, acidity determination and rate of precipitation of sludge.

Two types of oxidation products are formed—(1) asphaltic material, insoluble in the oil, and (2) free acids soluble in the oil, which form soaps with heavy metals in presence of water.

The results of this stability test have been found to indicate substantially the behaviour of oils in actual use in dry turbines. A. R. S.

177. Prediction of Flash Points of Blends of Lubricating Oils. E. W. Thiele. *Ind. Eng. Chem.* **19**, No. 2, February, 1927.

The principle underlying the prediction of the flashpoints of blends of lubricating oils may be expressed thus: the reciprocal of the antilogarithm of one-hundredths of the flashpoint in degrees Fahrenheit is an additive property of the oil.

Thus, if F, F′ and F″ are the flash-points in degrees Fahrenheit of three oils, and X, X′, X″ the volume fractions of the three constituents, then Fm the flashpoint of the mixture

$$= -100 \lg [X-F/100+X'-F'/100+X''-F''/100)$$

Examples are given and a table for finding the flash-point of blends of two oils whose flash-points are known. K. B. R.

178. Improvements in or Relating to Colour-estimating Apparatus. F. E. Lovibond. E.P. 263,924, January 3rd, 1927.

The invention describes a method for producing artificially a white reflected light for use in colour testing or colour matching observations. The artificial white light is comparable with ordinary diffused white daylight, and in the invention is used in conjunction with the Tintometer colour testing apparatus.

An electric lamp is mounted above the Tintometer, and in such a position that its axis is at 15 deg. with the line of vision. It is surrounded by an open ended, cylindrical shield, lined with white asbestos cloth. The light rays from the lamp are thrown on to a reflector placed at 45 deg. with the line of vision and diffused light is then reflected to the eyepiece of the instrument. The reflector consists of a tray containing a quantity of white powder, the latter being flat and smooth, and covered with a sheet of glass. The glass is of a blue tint, and of such a depth as to counteract the effect of the red and yellow rays emitted by the lamp. W. H. T.

See also Abstracts Nos. 125, 136, 137, 151 and 228.

Refinery Plant.

179. Fractionation in Petroleum Refining. G. A. Burrell. *Oil and Gas Journal*, Feb. 24th, 1927.

The article gives a brief sketch of the history of fractionation. Starting with the Coffey still in 1832, he points out that no great advance has been made, this still meeting all the conditions of good rectification to-day except that reflux of the same composition as the overhead cut was not returned to the column. Sorel's mathematics for binary mixtures, later simplified by W. K. Lewis, are used to-day. Nothing basic in rectification has been added since Linde's (1905) low temperature work.

Of the columns at present in use, the bubble tower appears to give the best rectification. Many packed columns are in use, but they do not give the sharp separation in the minimum of space found in a bubble plate column. Yields are being greatly increased by careful rectification, particularly with natural gasoline. S. W. C.

180. Improved Fractionation in Petroleum Refining. D. B. Keyes. *Chem. and Met. Engineering*. March, 1927.

The author urges the use of better and more scientific apparatus in petroleum refining and particularly in fractionation. In this way much of use might be learnt from the alcohol industry. He points out that though a reflux condenser was described by John French in 1651 it has only recently been used in general practice. With regard to columns operating on cracked petroleum distillate he remarks that a bell cap fractionating plate has proved efficient because it holds bodies of oil at a definite temperature for appreciable lengths of time, giving a chance for gummy bodies to form. S. W. C.

181. Recovering Sludge Acid at Refineries. O. Mantius. *Oil and Gas Journal*. March 10th, 1927.

Large quantities of sulphuric acid are used for treatment of light oils, cracked distillates and lubricating oils. The sludge acid consists of oil, tar, asphalt, resinous products, naphthenic and sulphonic acids, free sulphuric acid and water. Light oil sludge contains from 30 to 40 per cent. of oil and has 45 to 55 per cent. acidity; lub oil sludges contain only 25 to 30 per cent. oil and an acidity of 25 to 40 per cent. From 100 barrels of sludge 45 barrels of oil and 12 tons of acid can be recovered, giving a profit of $70 to $100, so that the installation should be paid for in fifteen months to two years. The sludge is discharged into vessels previously filled with an equal amount of warm water. The mixture is agitated with steam and air and cooked until the decomposition of the sulphuric acids is complete. Heavy oil sludge should be mixed with light oil sludge or with 25 to 50 per cent. of gas oil in order to make the tar and asphaltic products soluble. After cooking, the mixture is allowed to settle. Light oil sludge requires cooking from two to three hours and heavy oil sludge from three to five hours. Large quantities of SO_2 fumes are given off during the separation. After separation is complete the weak acid is drawn off into storage tanks and the oil into neutralising tanks, where it is washed with water or alkaline solution and then pumped into the central fuel system.

Separation is carried out in open tanks which are lead lined and have either a slanting or conical bottom. Steam and air are admitted through open coils of lead or brass. The capacity of the tank should allow ample room for the spattering of the acid during cooking. The neutralising tank

should have twice the volume of the oil coming from the separator, so that there is plenty of room for the alkaline solution or the fuel oil to be mixed.

The weak acid usually has a density of 28—32° Baumé. It should be free from suspended carbon, oil and tar, but usually contains small quantities of sulphonic acids which break up during concentration and cause foaming and entrainment losses if present in too large quantities. The best system of concentration is under vacuum, using steam for the first step up to 61° Baumé and hot oil for the final concentration to 66° Baumé. A rough outline of operating cost follows, from which it is concluded that a plant handling 100 barrels of sludge acid per day would pay for itself in fifteen months to two years, depending upon the type of sludge and the degree of concentration of the acid. S. W. C.

182. Ammonia in Arresting Corrosion. D. E. Pierce. *Oil and Gas Journal*, Feb. 24th, 1927.

The method described uses ammonia solutions in arresting corrosion in pipe and pressure stills. The plant consists of an underground tank containing a solution of ammonia of 17—22 per cent. strength, depending on the crude used. This is connected to an elevated cylindrical tank, from which the liquor flows by gravity to a pump connected by a series of levers to the main feed pump for crude oil. Thus the liquor is delivered in admixture with the crude to the first exchanger. The amount of ammonia liquor used is 50 per cent. in excess of that required to neutralise all the H_2S formed. Thus it is claimed that very little corrosion occurs in the admiralty metal tubes used, and analyses of the condensed water showed a complete absence of copper. No quantitative data of the actual corrosion are given.

A. R. S.

183. Art of Distillation. D. M. Allan, Assr. to Standard Development Co. U.S.P. 1,621,229. March 15th, 1927.

The invention relates more particularly to the distillation of oils of high water content—e.g., bottom settlings. A usual type still is employed, operating at 420° F., the vapours passing to an expansion drum. The oil of high water content is pumped through two coils of pipes contained in the vapour space of the still, where the oil gets heated, and then passes to the expansion chamber, entering at the top and being sprayed downwards. Here all the water is vaporised and also any light products, and the heavy material is returned to the still, flowing over a baffle plate on entry. S. W. C.

184. Distilling and Refluxing Unit. H. H. Armstong. U.S.P. 1,616,840. Feb. 8th, 1927.

The oil to be treated passes first through a heat interchanger and then through a series of tubes situated in the firebox. From here the oil passes to the top of the still, where it is sprayed over a series of plates which serve as vaporisers. Here the light portions are evaporated and the heavy residuum falls through each successive plate to the bottom of the still. The depth of residuum in the bottom is regulated, the outflow passing through the heat interchanger. The vapours pass up a dephlegmator, where the heavier portions are refluxed and returned to the still, but also have to pass through a series of plates in the body of the still before reaching the still bottom. The vapours from the dephlegmator are condensed and collected. It is claimed that the unit is compact whilst giving good fractionation. S. W. C.

185. Apparatus and Process for Fractional Distillation and Condensation. J. E. Bell, Assr. to Sinclair Refining Co. U.S.P. 1,619,396. March 1st, 1927.

The process provides for a battery of stills and heat exchangers. Crude oil passes through the preheater countercurrent to residuum from the last still, then through the heat interchanger countercurrent to the vapours from the first still, into the first still where it is raised to the desired temperature. From here it passes through the next heat interchanger and still, and so on to the last still, from whence the residuum is pumped through the crude preheater to storage. The vapours from the first still are passed through the first interchanger to a condenser. Those from each of the other stills, after being passed through the adjacent heat interchanger are circulated through pipes in the body of the next cooler still, where they are largely condensed, the condensate being run off and the remaining vapours passing along with the vapours of that still through the next interchanger. It is claimed that the oil is thus subjected to fractional distillation and the vapours to fractional condensation in a manner which secures a high degree of sharpness of cut, and also gives a minimum heat loss. S. W. C.

186. Method and Apparatus for Treating Petroleum Hydrocarbons. W. M. Cross. U.S.P. 1,621,475. March 15th, 1927.

Oil and acid are passed through valves into a line and the mixture pumped to a homogenizing valve, which separates the particles of the combined liquids into a spray or mist, inducing much more intimate contact than is obtained by agitation or mechanical mixers. The homegenized mixture then passes through a tube containing a plurality of vanes which produce still further turbulence to a centrifuge. This separates the lighter oil from the heavier acid, which is thrown to the outside and drawn off through a pipe ready for re-use. The oil is withdrawn from the centre of the centrifuge and is passed to an agitator, where it is mixed with clay or other adsorbent. A device is fitted whereby the oil may be circulated any number of times through the agitator. Oil is drawn off as required and passed to a filter press, where the clay is removed. The clay when ignited is ready for re-use. It is claimed that the rapidity of content of acid and oil eliminates, to a great extent, polymerisation. Also, the water wash after acid has been dispensed with, because addition of water tends to produce a hydrating re-dissolving of certain of the resinous compounds. S. W. C.

187. Distillation of Liquids such as Petroleum and Similar Hydrocarbons: Improvements in. De Bataafsche Petroleum Mattschappij. E.P. 253,489, April 20, 1926. Conv. (Holland) June 13th, 1925.

A distillation process is claimed in which the raw material passes through pipe ovens, where it is heated to at least the boiling point at the pressure used, and is then fractionated by means of vaporisers, dephlegmators, etc. A high vacuum is maintained and all parts of the plant are so connected to be at substantially the same degree of vacuum. The residue from the vaporisers may be again led to the pipe ovens, preferably by an independent pipe system. G. S.

188. Apparatus for Treating Hydrocarbons. G. Egloff and H. P. Benner. U.S.P. 1,618,645, 1927. Appl., July 15th, 1920, and August 14th, 1926.

The features of the apparatus are the provision of a heating element which extends through the still and the rotation of the major portion of the still

around the heating element. The connections between the rotatable part of of the still with the stationary part at one end, and with the centrally heated tube at the other, consist of movable tongue and groove, fluid-proof joints. The pipe connections to introduce raw oil and to withdraw residues and distillates are made in the stationary end of the still. H. G. S.

189. STILL. H. E. Gilbert. U.S.P. 1,621,319. March 15th, 1927.

The patent provides means for evenly distributing the heat over the surface of a still, whether of the shell or tubular type. The still is divided from the firebox by a wall which varies in thickness and therefore in conducting power. Where the burner enters and the flame is hottest the wall is thickest, and it gradually thins down till near the end of the flame it is pierced by several holes. This, it is claimed, gives an even distribution of the heat over the whole surface of the still. S. W. C.

190. PETROLEUM-TREATING APPARATUS. J. W. Lewis, Assr. to Atlantic Refining Co. U.S.P. 1,606,248 of Nov. 9th. Appl., April 19th, 1917.

Horizontal drums connected by tubes are disposed at different levels in a heating chamber in a pressure-still structure. A still outside the heating chamber extends from above to below the drums. The drums and still are connected, and there is a vapour discharge line above the liquid level in the still. H. M.

191. DISTILLATION OR EVAPORATION OF LIQUIDS. J. L. Major and B. Taylor. U.S.P. 1,614,483. Jan. 18th, 1927.

This patent claims the method of distillation of tar or oil by feeding the liquid into the still through a plurality of feed conduits of relatively great oblong cross section. These conduits are vertical, and the oil passes upward, being heated in its passage by the liquid in the body of the still before it is delivered in finely divided condition above the liquid surface in the still. A. R. S.

192. APPARATUS FOR THE HEAT TREATMENT OF MATERIALS. A. McD. Dougall. U.S.P. 1,610,078, 1926. Appl., Jan. 17th, 1924.

The invention is applicable to molten metal baths for the distillation of tar, oil or the like as in, say, U.S.P. 1,527,847, and has for its object the removal of free carbon, ash, etc., from the surface of the metal. The still is provided with the usual vapour line and with an outlet above the surface of the metal for the treated material, the latter being continually directed to the outlet by means of slowly rotating puddles in conjunction with baffles. H. G. S.

193. PROCESS OF AND APPARATUS FOR REFINING PETROLEUM. F. A. Milliff and J. A. Milliff. U.S.P. 1,620,163. March 8th, 1927.

Crude oil is passed through heat exchangers and a water separator to a tube still, where it is heated to 500° F. From here it passes to a vaporiser, where the lighter hydrocarbons are separated, leaving a residuum which is passed back through the heat exchangers to a storage tank. The mixture of vapours is passed from the vaporiser to a centrifuge, where all mechanically entrained liquid is separated, the dry hot vapour passing to an intercooler. The intercooler is surrounded by a liquid whose temperature can be controlled, and by this means a portion of the vapour is condensed. The whole then passes to a condensate separator and reboiler, where the condensate is separated and kept at a given temperature in the reboiler for a considerable

distance of flow, thereby separating any vapours which have been carried down with it. The reboiler is heated with residuum and steam.

The intercooler, condensate separator and reboiler comprise one fractionating unit from which one fraction is withdrawn from the mixture of vapours. There are a number of these fractionating units provided, the number depending upon the fractions desired. The condensate passes to a heat exchanger and the vapour to the next intercooler. It is claimed that this process prevents cracking and gives complete separation of the fractions.

S. W. C.

194. Oil Distillation Apparatus. F. M. Poole. U.S.P. 1,615,479. Jan. 25th, 1927.

Apparatus is described by means of which the vapours, after distillation, may be cooled to a definite temperature in a vapour-oil separator before passing into a condenser, at the same time heating up part of the oil with which the still is charged. A constant flow of oil is kept in the still, part of this coming direct from the pump, and part first passing through the pipes used to cool the vapour. In order to cool the vapour to the desired temperature more or less oil is passed through these pipes as required. The oil flow is regulated by two linked valves, which are automatically actuated by a motor controlled by a thermo-couple or other temperature measuring device placed in the vapour.

P. D.

195. Tube Still Regulation. F. M. Poole. U.S.P. 1,615,480. Jan. 25th, 1927.

This patent provides an improved method and means for regulating the operation of tube stills by controlling the supply of fuel to the still furnace by means of a valve actuated by a relay motor. This is in turn controlled by a thermo-sensitive device, such as a thermo-couple, situated at a point in the oil stream between the entrance to and exit from the still where the oil has not yet reached its maximum temperature. In addition to the advantage of automatic action it is claimed that since the control is actuated from a point more or less remote from the exit the time lag between a change in oil temperature and the necessary change in heating is less than would be the case were the relay controlled by the oil temperature at the exit, and also that the heat insulating effect of deposited carbon will upset conditions less than in a plant controlled from a thermo-couple in a pocket at the exit.

E. R. B. S.

196. Tube Still Control. F. M. Poole. U.S.P. 1,615,481. Jan. 25th, 1927.

This provides an improved method and means for controlling the combustion in the furnace of a tube still in such a way as to secure the proper heating effect while maintaining efficient combustion conditions in the still furnace. The fuel supply to the furnace is controlled by a valve actuated by a relay which is in turn controlled by a thermo-responsive device, such as a thermo-couple, at or adjacent to the still outlet and in the oil stream. The air supply to the furnace, or alternately the opening for exhaust gases, is controlled by a relay actuated by an automatic carbon dioxide analysis apparatus which adjusts the air supply to give a constant and predetermined proportion of carbon dioxide in the flue gases. In the typical apparatus described the carbon dioxide content is estimated by an electrical analysis apparatus which consists of an energised Wheatstone bridge, of which two of the resistance arms are contained in gas vessels. One of these vessels is sealed and contains a standard comparison gas, while a portion of the flue

gases are caused to circulate through the other. The bridge having been balanced to correspond with a certain carbon-dioxide content in the flue gases any variation in this content will cause a change in thermal conductivity of the gas, which will cause a change in the temperature of the resistance immersed in it with a consequent change of resistance which will upset the balance of the bridge. This lack of balance is caused to actuate the relay controlling the air supply and so bring back the flue gases to their original composition.

It is claimed that by means of this invention the oil under treatment may be heated to a practically constant exit temperature, and that since the degree of combustion is also automatically controlled the thermal efficiency of the plant reaches a constant value which may be the maximum practically obtainable. E. R. B. S.

197. Oil Still. John Primrose, assr. to Power Specialty Co., New York. U.S.P. 1,614,689. Jan. 18th, 1927.

This patent claims the method of fractional distillation by heating the still externally and passing the vapours from it through a series of air-cooled condensers maintained at different temperatures, and returning the heated air to the furnace to promote combustion of the fuel supplied to the furnace. From each condenser a different fraction is drawn off. A. R. S.

198. Continuous Distillation of Crude Petroleum Oils. F. M. Rogers and R. E. Wilson, assrs. to Standard Oil Co. U.S.P. 1,615,407. Jan. 25th, 1927.

This patent claims the method of continuous distillations of petroleum oils by reducing the crude oil with fire and open steam to bring it to a residue of not more than 20 per cent. on the crude, after which the residue, accompanied by steam, is passed through a coil heated to 700–800° F. The heated oil and steam pass therefrom into a vaporising chamber maintained at a reduced pressure of less than 4″ mercury, in which a separation of vapour and unvaporised liquid takes places. A. R. S.

199. Method and Means of Treating Oils. E. C. Weisgerber. U.S.P. 1,616,209.

An apparatus is patented for producing an intimate mixture of two (or more) fluids. In the simpler case the one fluid is forced into the body of the other through a set of small nozzles, the mixture then passing into any piece of plant in which treatment is to take place. The introduction of a third liquid necessitates a second set of nozzles through which the mixture first formed is projected into the body of the third liquid. The function of the unit is to give a large surface of reaction between the fluids, and it may be applied to oil-treating plant in a number of ways. P. D.

200. Apparatus for Heating Stills. G. D. White, assr. to Texas Co. U.S.P. 1,621,298. March 15th, 1927.

The invention provides for means of heating stills, preferably of the vertical type, whereby the furnace encloses the middle portion of the still only. The bottom is left cool, so that carbon and residuum may collect there and be drawn off. The top portion, the vapour space, is also left unheated. The furnace is elliptical in shape surrounding the stills. There are two rows of portholes, one at the top and the other at the bottom, each porthole being closed by a door, whose weight is sufficient to keep it closed and thus retain the gases inside. But in case of explosion these doors can swing on their hinges and relieve the pressure. Gas or oil is supplied from two main feed

lines, one down each side of the stills. From these vertical lines run up, from which again horizontal burners are taken off at various intervals, the burners being made to play upon the intermediate spaces and not on the stills, which gives a more even distribution of heat. Each burner has a separate valve, so that great ease of regulation of temperatures can be obtained. At the end of a run the doors of the portholes are opened, thus giving a good draught, which quickly cools the plant. It is claimed that this apparatus effects a substantial reduction of the temperature differential between still and furnace, and lessens the tendency to bake carbon deposits.

S. W. C.

See also Abstracts Nos. 130, 131, 141, 145, 149, 153, 154, 155, 156, 162, 256, and also those under the heading of "Cracking."

Engineering.

201. Heat Insulation. J. S. F. Gard. *J.S.C.I.*, **46**, 12.

The author divides the cases in which there is a need for efficient heat insulation into four classes:—(1) refrigerators, (2) boilers and steam systems working up to 700° F., (3) superheated steam systems, (4) furnaces and kilns. As the result of experimental work in which the heat loss from a closed lagged pipe was determined from the input of watts to an internal heater which was necessary to maintain a constant temperature, the author reaches the following conclusions regarding the best medium for use in each case:—(1) The most satisfactory is sheet cork. This may be made to the size of pipe to be covered, and is easily worked. It is also impervious to water, and comparatively resistant to fire. (2) 85 per cent. magnesia powder with 15 per cent. asbestos as a binder. This is by far the most efficient insulating material. Above 700° F. the magnesia undergoes a change, and this limits the use of the medium. For this reason for (3) a first layer containing less magnesia is recommended in order to bring the insulation to below the 700° F. point on the temperature curve, after which 85 per cent. magnesia may be used. (4) Kieselguhr bricks are recommended for these cases. Several experimental results are given, and the effect of various insulators on a small steam plant is worked out.

P. D.

202. Doulton Stoneware Centrifugal Pump. *The Industrial Chemist*, Feb., 1927, 62.

This anti-corrosive pump has just been produced by Messrs. Doulton and Co., Ltd., of Lambeth, and has several noteworthy points. Every detail of the pump, except the outer iron casing, is made of special acid-proof stoneware. The shaft is not specially mentioned, and therefore it is presumed that this is included in the details made of stoneware. The rotor is in the form of a disc with robust impeller blades projecting from one face and a series of small flat impellers on the opposite face, which sweep back any liquid tending to approach the gland and cause leakage. A cock is provided for draining the pump, and also an aperture for washing out. The pump may be supplied in six sizes, with outlets ranging from 1½ ins. to 3½ ins. diameter and capacities of from 1,000 gallons per hour with the 1½-in. outlet to 10,000 gallons per hour with 3-in. outlet and greater still with the larger size. The pump will work with ease against a head of water of 60 ft. It may be obtained direct coupled to an electric motor or arranged for belt drive with fast and loose pulleys mounted on Skefco ball bearings.

E. R. B. S.

203. Light-Weight Oil Engines. European and American Progress in Design. Johnstone-Taylor. *Gas and Oil Power*. March, 1927.

The uses cited for this type of engine are rail motor-cars, evacuating machinery and high-speed light motor craft. The Beardmore type is an all-steel construction having the main crankcase of monoblock form, bored to receive steel cylinder liners, and so form the water jacket. The cylinder heads and pistons are of aluminium alloy, the pistons having six compression rings and a scraper ring all of cast iron. The fuel injection valve is situated in the centre of the cylinder head and is operated by rockers driven from a camshaft mounted independently on the main casting. In the Mumford's, Colchester, design the cylinders are of cast iron bolted to the crank chamber. There are four valves to each cylinder, and these are placed in removable cages, the fuel valve being in the centre and the oil being sprayed vertically downwards by a special device. The Bagnulo, an Italian engine, works at low compression, and the iron cylinder liners are cast integral with the crank chambers, while the head which contains the camshaft bearings is detachable. The American designs are mainly constructed of cast iron, the camshaft of the North-West Engineering Co.'s design being disposed similarly to Beardmore's. The atomizer is situated in the exact centre of the head, which is conical, while the piston is domed to suit this. The fuel is supplied by an eccentrically operated pump which supplies a common feed to all cylinders at uniform pressure. A. R. S.

204. The Metering of Fluids. H. Moren Brown. *Industrial Chemist*, March, 1927.

This is a comprehensive survey of the methods available for the measurement of fluid velocity. An electrical method for estimating the flow when an orifice type of flow-meter is used is described. In outline the pressure difference is used to make a mercury column short-circuit a number of resistances which are placed in one arm of a Wheatstone's bridge. The flow may be observed from a glavonometer swing or a recording instrument may be used. P. D.

205. Variable Compression Engine for the Examination of Liquid Fuels. A. Oberle. *Petr. Zeitschr.* Jan. 10th, 1927.

A single cylinder engine is described so arranged that by movement of the cylinder vertically the compression ratio can be varied, while running under full load, between 2 : 1 and 9 : 1, rated at 4 horse-power, 550 r.p.m. The power generated is absorbed in a lamp resistance. The method of examining petrols for their respective points of incipient detonation is outlined. Graphs are given showing the power output with increasing compression ratio when different petrols are used, the power output in each case attains a maximum, the less easily a petrol detonates the higher the maximum power output obtainable, other conditions being equal. Several indicator cards of explosions under detonating and non-detonating conditions are illustrated. W. N. H.

206. The Prevention of Oil Pollution. *Oil News*. Feb. 26th, 1927.

The paper is a record of the Standard Oil Co.'s work, which includes education of its officers and crews in precautionary methods. The tanker's bilge pumps are equipped with a suction breaker which automatically prevents the discharge of oily waste when pumping bilges. Drip pans are placed under all cargo and bunker-oil connections. The residual ballast water is pumped into land storage tanks and all hose is tested monthly to a hydrostatic pressure of 125 lb. At El Segundo refinery some 20,000,000 gallons of salt water are

pumped from the ocean each day, and after being used for cooling are returned once more. In its passage through the refinery the water picks up a certain amount of oil, about 0·1 per cent by volume. In order to remove this oil before the water is returned a large separating system has been installed. In the large separator "skimming baffles" extend from the top of the tank to within 2 ft. of the floor. Between each pair of "skimming baffles" is placed a "retarding baffle," a short concrete wall rising from the floor. The water and oil enter the separator near the top at one end, discharging near the bottom at the other end. The water flows under the skimming baffle and is then deflected upward by the retarding baffle. This action keeps the water and oil moving towards the surface, thus assisting and accelerating the movement of the oil toward the surface. In each compartment is a skimming line—a swing pipe that may be raised or lowered to meet the changing oil surface—and oil is pumped off through these skimming lines. The water discharges into a channel and then passes through another set of baffles, where oil which is got by the separator is skimmed off the surface. From here the water passes into an 82-acre saltmarsh settling basin, where any remaining oil is deposited on the mud-banks and vegetation. The water passes out into the bay through two tide gates protected by a baffle plate.
S. W. C.

207. Interpretation of Steel Fractures. P. W. Priestley, M.I. &S. Inst., M.Inst.Met. *The Industrial Chemist.* Feb, 1927, 63–66.

This article deals in a non-technical manner with the factors governing the appearance of steel fractures. The fact that previous history bears an important part in determining the type of fracture is emphasised, and the principal governing factors are briefly outlined. Two micro-photographs of fissures in mild steel are given, one of an intercrystalline nature in steel which has been over-annealed, and one of a crystalline nature in steel which has been subjected to excessive cold working and subsequently to elevated service temperatures. Fractures in case-hardened pieces are dealt with and the importance of a tensile and impact test, in addition to the examination of a fracture, insisted upon. In general, fractures due to shock present a crystalline appearance, while those resulting from a gradually applied load are of a fibrous nature, the apparent fibres actually being the drawn out ends of elongated crystals.
E. R. B. S.

208. Heat Transfer Alignment Charts. M. Roulleux. *Chemical Eng.*, March, 1927.

In calculating the heat flow occurring when two liquids are separated by a solid wall it is necessary to know the mean temperature. This may be calculated from the known temperature conditions in the liquids, but the calculation is laborious. The object of the two charts given is to provide a graphical means of obtaining the mean temperature. The second chart may also be used to obtain the area of the heat transfer surface.
P. D.

209. Protection from Lightning. L. P. Stockman. *Oil and Gas Journal*, Feb. 3, 1927, 34.

As a result of investigations following upon many disastrous fires which occurred in the early part of 1926 it has been found that fires from lightning are caused in two ways, either by direct stroke or else by the sudden release of an induced discharge or electromagnetic induction at the time lightning strikes a neighbouring object.

The early conception that the electric field under a cloud could be reduced by silent discharges from sharp points has not apparently met with success, but although it seems impossible to prevent lightning, protection by means of directional control has been shown to be both possible and practicable.

Complete protection of oil is provided by storing it in all steel tanks or by covering reservoirs with continuous metal roofs of considerable thickness. These systems are, however, often prohibitive as regards cost.

Two distinct types of protection are being used in California, a horizontally suspended grid or network over the top and steel radio towers erected near the reservoir. The network is simply an outgrowth of the Faraday cage, while the towers are modern adaptions of the old-fashioned lightning rod, and designed to take direct hits without harm. Laboratory tests have shown that a zone of protection exists round a tower in the form of a cone with its apex at the top of the tower and its base covering a circle on the ground with a radius equal to four times the height of the tower. In these tests such towers, arranged so that their areas of protection will overlap, have been found to take all direct hits and it is believed that a similar law will apply to natural lightning. However, in view of the many secondary effects set up by a lightning discharge, it is still necessary to provide a network to take care of these, and it is advisable that this should be sufficiently robust to withstand the effects of any direct strokes which may miss the towers. Towers should be from 1·5 to 2·5 per cent. of the height of the cloud from which the stroke comes, so that for clouds 6,000 feet or more above the ground they may be about 150 feet high. With these towers only a considerable protection is afforded, but in order to avoid side flashes they should be placed at least two-thirds of their height away from the edge of the roof. When a lightning-stroke occurs there is a radial flow of electricity from all points within, say, half-a-mile towards the spot that has been struck, and consequently a risk that local sparks will occur between pieces of metal or damp patches on a roof which is not of all metal construction. The network system has been introduced to give protection in this respect and experiments have indicated its success.

A typical network consists of a circumferential wire of ¼-inch cable supported on 20 foot wooden poles arranged round the reservoir, each pole being gauged by two cables interconnected by a buried copper wire, and parallel wires of 12 gauge heavily galvanised steel wire, at 4 foot centres, slung from the circumferential cable across the reservoir. The parallel wires may be supported at the centre either by wooden poles resting on the roof, or from a catenary cable supported on 55 foot poles on each side of the reservoir. The network should lie about 12 feet above the reservoir roof, when it will reduce the potential on the latter to about 8 to 10 per cent. of that of the charge on the cloud above the tank. The effect of static charges must still be considered, and all metal parts or bodies likely to accumulate a charge should be connected to ground.

In addition to erecting towers and networks, Californian engineers are utilising inert gases, such as carbon dioxide obtained from flue gases, to displace the inflammable and explosive vapours from the space between the oil surface and roof.

Considerable attention is now being paid to the great risk of boil-overs in case of fire when there is any water present in the bottom of reservoirs. On this account crude oil is regarded as the most hazardous to store, as it usually contains more than 2 per cent. of water. The old practice of putting water in the bottom of concrete lined reservoirs, with the idea that in case of slight leakage of the bottom water will be lost and not oil, is particularly dangerous in this respect.

A general description of the oil storage arrangements at Watson, California, is given and an estimate of the slight risk to surrounding cities and harbours in case of a general conflagration there.

Emergency handling conditions following upon a period of over-production of oil have been held responsible for certain large fires, and in cases where absorption vacuum has been applied to draw gas from reservoirs for the extraction of casing-head gasoline this is believed to have drawn sufficient air into the vapour space to form an explosive mixture. It is not believed that the boil-over hazard has really been measured properly, even by oil companies whose engineers have conducted extensive experiments and studied oil fires closely. No doubt account will be taken in the future of the wave due to velocity and greater spacing provided around containers of undehydrated crude.

An arrangement for protection against lightning has recently been introduced known as the Cage system. This system relies upon the fact that the energy released in a lightning stroke is relatively small, although the extreme rapidity of the discharge gives rise to immense currents. By means of a series of barbs or points on wires supported on poles round a reservoir it is claimed that the energy in a cloud is discharged in a similar time, one or two minutes, as is required to build it up.

Three strands of wire are used on poles 80 to 100 feet high, and these are connected to ground water and all metallic points such as pipelines, the reinforcing of cement, wire fences, etc. E. R. B. S.

210. Cage System of Lightning Prevention and its Application to the Oil Industry. E. H. Wilcox. *Oil Age*, 24, 3, 20.

Every lightning protection system prior to the advent of the cage system proposes to prevent the damage caused by lightning discharges by guiding and controlling the direction of the flash and conducting it to the ground along a prepared path. This controlled direction, however, does not affect the number, position, or intensity of secondary discharges. The cage system aims at the reduction of the charge in the cloud and on the earth, so that no discharge takes place. It is known that when a charged point is brought into proximity to a plate charged with the opposite potential, it will give up its charge to the plate, thereby neutralising both point and plate. The period of discharge is approximately ·001 of a second, but the time taken to build up the charge will vary with the intensity of the inter-cloud action, being from 50 sec. to 5 min., or even more. Now, if the charge can be neutralised as fast as it is generated, and not allowed to accumulate to the breakover point, only very small amounts of energy need be handled in a given unit of time.

The cage system proposes to make use of this time element by discharging the ground to the cloud simultaneously with the charging up period. The discharge of energy from a point or series of points varies directly with the potential difference between plate and point, and inversely with the distance between them. The ratio can be expressed as a curve with the discharge rising more rapidly as the distance decreases or the gradient increases, but apparently less rapidly than the square of the gradient. The natural action, then, of a properly proportioned series of points arranged in the presence of an electric field under the influence of a charged cloud will be that when the potential begins to build up in the cloud, a steady discharge of ground potential back to the cloud will take place. Eventually the discharge of current from the earth will equal the charging rate of the cloud, and here an equilibrium will be maintained, with a potential so low that there will be no possibility of a stroke of lightning from cloud to earth.

In practical construction, a reservoir or other area to be protected is surrounded by a ring of wires at a suitable height above the object to be protected and completely surrounding the area. This cordon of wires consists of three parallel strands of a special barbed wire arranged in a horizontal plane and supported on steel towers about 80 ft. above the level of the reservoirs. Laboratory experiments show that the charge is removed from within a completely enclosed circuit of wires, but that at a short distance outside the circuit the ground charge is not materially affected. It has also been shown that to protect three sides removes but a small portion of the charge from within. It is not until the circuit is completed that full protection is afforded. Every part of the structure is bonded to the dissipating wires and properly grounded into permanent ground water at frequent intervals.

W. H. T.

211. Fluid-Heater Control. F. M. Poole, Assr. to Brown Instrument Company. U.S.P. 1,615,478, 25.1.27. Appl., 6.7.25.

The apparatus claimed consists of a heat regulator and means of adjusting it to heat oil to different temperatures as the pressure varies. The heat regulator control includes a galvanometer, a thermocouple responsive to temperature and, connected to the galvanometer, a device responsive to pressure for changing the galvanometer constant on changes in pressure of the fluid.

G. S.

212. Heat Transfer, Improved Method and Apparatus for. A. E. White from Gas Research Company. E.P. 265,358, 12.1.26.

A method of transferring heat from a hot fluid to the fluid to be heated by means of rapidly draining the heat from the fluid by radiation to a heat absorber so arranged to divide the fluid to be heated into thin streams.

The apparatus comprises a good heat radiating material, and a good heat absorbing material having a relatively large surface area and arranged to bring every particle of the fluid to be heated into contact with the second body so that it rapidly imparts to the fluid the heat it receives from the first body.

G. S.

213. Thermostatic Control of Temperature in Furnaces, Improvements in. H. Wiggin and Company and A. G. Lobley. E.P. 265,521, 1.10.25.

The apparatus claimed comprises a switch or other heat-controlling device which is tripped in one direction by a spring embodied in the switch mechanism, and a thermostat, the high-expansion element of which is held in contact with a low-expansion element by loading springs stronger than the switch spring. The loading springs are arranged, under control of the thermostat, to trip the switch in the opposite direction to that of the switch spring.

G. S.

See also Abstracts Nos. 119, 130, 139, 144, 146, 154, 155, 165, 182, 195, 196, 231, 254, 255, 257 and 272.

Anti-Detonation.

214. Gaseous Explosions. Effect of Fuel Constitution on Rate of Rise of Pressure. G. G. Brown and G. B. Watkins. *Ind. and Eng. Chem.*, Feb., 1927.

The rate of rise in pressure on explosion was observed using the following substances mixed with approximately theoretical proportions of oxygen

and nitrogen—n. hexane, heptane, octane, benzene, toluene, xylene, methyl ethyl and amyl alcohols and ethyl ether. A steel bomb 6·99 cms. diameter, 17·8 cms. long, capacity 395 c.c. was used. The mixture was fired by a sparking plug located centrally in one end. The temperature was recorded by a centrally situated thermocouple. The composition of the resultant gases was determined. For recording time-pressure curves a modified Midgley indicator was used comprising a piston held almost flush with the bomb walls by a heavy spring. A thin piece of indiarubber situated in between the piston head and the bomb prevented gas leakage. A rod connected to the piston was coupled to a concave mirror throwing a spot of light on to a rotating drum, whereby diagrams of the pressure rise with time could be obtained. The apparatus was calibrated by application of aromatic static pressure to the piston. The pressure time diagrams were differentiated to obtain the rate of rise in pressure.

The following conclusions are drawn. The rate of rise of pressure increases with molecular weight in the paraffin series; it varies inversely with the number of methyl groups added to the benzene ring in the aromatic series; it is approximately the same for n. octane and for benzene, for n. heptane and toluene, and for n. hexane and xylene; it is about the same for the higher alcohols as for the corresponding paraffin hydrocarbons; it is exceedingly rapid for ether. Thus the rate of rise of pressure cannot be the sole factor determining the tendency of a fuel to knock in the internal combustion engine. W. N. H.

215. Gaseous Explosions. IV. The Rate of Rise of Pressure, Velocity of Flame Travel and the Detonation Wave. G. G. Brown and G. B. Watkins. *Ind. and Eng. Chem.*, March, 1927, 363—366. A continuation of a paper, *Ind. and Eng. Chem.*, 19, 280 (1927).

The results of previous workers on the subject is discussed, particularly as regards the relation of a diluent on the rate of rise of pressure and the propagation of the detonation wave in gaseous mixtures. The authors measured the maximum pressure and time taken to develop maximum pressure in various mixtures of isohexane and oxygen. The results are in line with Dixon's on ethylene and oxygen, and show that the mixtures having maximum velocity of flame and maximum rate of rise of pressure contain slightly more oxygen than that just necessary to form carbon monoxide and hydrogen.

Detonating theoretical mixtures of n. hexane, n. heptane, n. octane, benzene, toluene, xylene, methyl alcohol, and ethyl alcohol were exploded with varying amounts of nitrogen as a diluent until the detonation wave was just eliminated. A fairly good straight line relationship was established between % of nitrogen present in order to eliminate detonation and maximum rate of rise of pressure. The rate of pressure rise of an explosion is the major factor determining the tendency of the mixture to detonate, but as the aromatic hydrocarbons have much less tendency to "knock" in an internal combustion engine, the authors conclude that the detonation wave, as is recognised in progressive homogeneous reactions, is not the cause of knock in the I. C. engine. W. N. H.

216. Gaseous Explosions v. The Probable Mechanism Causing "Detonation" in the Internal Combustion Engine. G. G. Brown and G. B. Watkins. *Ind. and Eng. Chem.*, March, 1927. 366—369.

The authors quote the following facts concerning time detonation waves and engine "knock." A. An increase in the initial temperature (except

in mixtures containing an excess of fuel and below 75° C.):—(*a*) Decreases the velocity of the detonation wave set up in gaseous explosions in long tubes. (*b*) Decreases the rate of flame propagation in progressive homogeneous explosions in cylindrical bombs. (*c*) Decreases the rate of rise of pressure in gaseous explosions in bombs. (*d*) Decreases the tendency to initiate detonation waves in cylindrical bombs. (*e*) Increases the tendency to knock in I. C. engines. (*f*) Increases the tendency to initiate autoignitions of unburnt gases ahead of the flame in bomb explosions. B. An increase in initial pressure:—(*a*) Increases the velocity of the detonation wave. (*b*) Increases the rate of rise of pressure in bomb explosions. (*c*) Increases the tendency to initiate detonation waves in bomb explosions. (*d*) Increases the tendency to initiate engine knock. C. The addition of diluents:—(*a*) Decreases the velocity of the detonation wave. (*b*) Decreases the velocity of flame travel before the detonation wave is initiated. (*c*) Decreases the rate of rise of pressure in bomb explosions. (*d*) Decreases the tendency to initiate the detonation wave. (*e*) Decreases the tendency to initiate engine knock. D. Surface conditions of the combustion chamber:—(*a*) Have no effect on the velocity of the detonation wave set up in long tubes. (*b*) Have a pronounced effect on engine knock; carbon deposit and hot surfaces increases the tendency to knock. The authors consider that these facts indicate that engine knock is caused by a reaction entirely different from the progressive homogeneous reaction of the detonation wave; it is rather caused by a heterogeneous reaction on the heated surfaces of the combustion chamber. Autoignition temperatures for various hydrocarbons are quoted and it is shown that for any hydrocarbon the maximum rate of rise of pressure divided by the autoignition temperature in °abs. is greater than 84 if the hydrocarbon tends to knock, but is less than that figure if it is a knock suppressor. The authors conclude that autoignition of the unburnt part of the charge caused by adiabatic compression against heated surfaces is the mechanism of combustion causing engine knock. W. N. H.

217. Report on Dopes and Detonation. H. L. Callendar, R. O. King and C. J. Sims. Aeronautical Research Committee Reports and Memoranda, No. 1013, Nov., 1925.

A review of previous work on, and theories of, detonation in the internal combustion engine is given. The writers consider that the nuclei (consisting chiefly of heavy paraffins) of liquid fuel present in the charge during explosion are the most usual cause of detonation. These high boiling-point paraffins have the lowest ignition temperature of all the constituents of petrol; furthermore, chemical action starts most readily at a surface of separation such as a drop surface. From the examination of the entropy-temperature diagram for pentane it is deduced that adiabatic compression of the saturated vapour of a paraffin leads to condensation. The freshly ignited carbon particles present in the cylinder will probably serve as foci of condensation. Three types of detonation are distinguished—(1) the pressure-wave type, depending on the development of a pressure difference into a pressure-wave sufficiently intense to fire the mixture, (2) the nuclear type depending on the presence of nuclei of low ignition-point throughout the mixture, (3) the molecular type in which the temperature of a completely vaporised mixture is sufficiently high to induce direct molecular combination; the second type is thought to be the most usual in the internal combustion engine. A tentative explanation is given on the nuclear hypothesis of the behaviour of carbon bisulphide and ether in an engine, the former preignites when undiluted, but acts as an anti-knock when blended with petrol; the latter acts as a pro-knock in all cases.

Observations were made on the effect of heating various "dopes" in sealed tubes. Lead tetraethyl boiled gently with decomposition at 210°, at 215° it exploded, shattering the tube, which was capable of withstanding 300 atm. at 400°. When this dope is used in minute quantities the violent decomposition would be sufficient to infect all the liquid nuclei in the engine cylinder with lead particles without establishing pre-ignition. When lead tetraethyl was heated with ethyl ether decomposition occurred at 243°, a yellow cloud, probably PbO, being formed. This explains the destruction of the anti-knock effect of $Pb(Et)_4$ by ethyl ether. "Ethyl fluid" (a mixture of lead tetraethyl and ethylene dibromide) showed on heating deposition of lead which later reacted to form the bromide. With water, $Pb(Et)_4$ decomposed at 193° leaving a pellicle of lead in the tube. Nickel carbonyl started to decompose at 100° and was heated to 260° without explosion, the action is reversible on cooling. Owing to its greater volatility compared with lead tetraethyl, nickel carbonyl is far less likely to become concentrated in the nuclei. Other organic compounds were sought which might reasonably be expected to act as dopes, the desired criteria being solubility in petrol, boiling point about 200°, high ignition-point and critical temperature above 400°. The aromatic amines have these desired properties and are well known as anti-knock substances. Phenyl hydrazine was found to explode in the sealed tube at 360°, this probably explains its knock-inducing action. From an examination of the critical temperatures and pressures, and the latent and specific heats of the higher paraffins likely to be present in petrol it is shown that the presence of liquid drops in the engine cylinder at the time of ignition is possible.

A large number of engine tests in connection with detonation problems were carried out on a Ricardo E 35 engine the compression ratio of which was infinitely variable between 3·8:1 and 7·9:1 while running under full load. An audibility test was standardised for the determination of the intensity of detonation developed, fixed dual ignition was used. It was found that the addition of ·2 per cent. by volume of lead tetraethyl to petrol caused an increase in highest useful compression ratio (H.U.C.R.) of 32 per cent., while 4 per cent. gave an increase of 50 per cent. The anti-detonating effect of ·1 per cent. lead tetraethyl is destroyed by using 50 per cent. of ethyl ether in the engine fuel. With a slightly closed throttle the same quantity of lead tetraethyl was found to make a smaller percentage increase in H.U.C.R. compared with full throttle position. The H.U.C.R. of hexane, octane and nonane were found to be 4·8, 4·8 and 3·9:1 respectively. Arranged in order of decreasing anti-knock efficiency the order was found to be alcohol, toluene, benzene for a 25 per cent. addition of each to petrol, while for 100 per cent. addition the order was toluene, alcohol, benzene.

A large number of organic substances were tested for anti-knock effects using a 5 per cent. solution of the substance in petrol; diethyl aniline was found to be ineffective as an anti-knock, and monoethylaniline has half the anti-knock effect of aniline. Monomethyl aniline is slightly more effective than aniline, while dimethyl aniline is less than one tenth as effective as aniline.

No relation can be traced between the anti-knock efficiency and the boiling points of the members of the aniline group. The toluidines showed the following percentage increases in H.U.C.R. in the following blends:—

	Concentration.	
	6%	15%
Ortho	16·3% increase	43% increase
Meta	16·6% ,,	49% ,,
Para	14·3% ,,	—

Similar values for the xylidines are as follows:—

	Concentration.	
	6%	15%
Ortho	20·3% increase	49·4% increase
Meta	20·3% „	63·8% „
Para	15·3% „	39·8% „

The distillation curves of several standard petrols were not appreciably altered by the addition to the petrols of 3 c.c. lead tetraethyl per gallon.

The calorific values of various aromatic amines were determined and it was shown that a blend containing 15 per cent. by weight of aromatic amine in petrol would have a calorific value only 2 per cent. less than that of the unblended petrol. W. N. H.

218. Dopes and Detonation (1926), Part II. H. L. Callendar. *Engineering*, Feb. 4, 11, and 18, 1927.

A continuation of Report 1013, published by the Committee of Aeronautical Research. The chemical reactions likely to occur in the cylinder charge during compression before ignition were studied. Atmospheric pressure was used throughout the experiments, which consisted in passing mixtures of hydrocarbon vapours and air through an electrically-heated combustion furnace and analysing the products. Aldehydes were found to be the major portion of the product of incipient oxidation, the temperature of which was in general far below the reported ignition-point of the fuel. In the case of the paraffins the aldehyde was accompanied by CO_2 and H_2O, furthermore the addition of anti-knock dopes to the mixture prevented the formation of aldehydes at temperatures at which they normally would have been formed. Aldehydes were found not to be knock-inducers themselves. These facts led to theory that the first compound found in the oxidation of paraffins was of the peroxide type, a complete oxygen molecule being added without disruption, and that it was these peroxides which gave rise to detonation. Peroxides prepared synthetically were found to be violent knock inducers.

The glass combustion tubes used were 50 cms. long and 12 mm. diameter. Gas velocities were 1 litre per hour in general. A 10 per cent. hexane—90 per cent. air mixture by weight showed signs of decomposing into aldehydes, CO_2 and water at 325° C., increase of hexane content in the mixture lowered the temperature at which decomposition occurred, 33 per cent. hexane mixture decomposing at 206°. Paraffins from octane to undecane started to decompose at 205–215° C., aromatic hydrocarbons at 540° to 670°, alcohols at 390°–570°, aromatic nitro bodies at 395–420°, iso amyl nitrite at 195°, ethers at 145°–185°, aldehydes at 135°–300°, fatty acids at 300°–450° aromatic amines at 405°–550°, quinoline at 480°, pyridine at 320°, carbon bisulphide at 195°.

Examination was made of the effect of mixture strength on the temperature of initial combustion (T.I.C.), hexane and pentane exhibit a minimum T.I.C. at about 30 per cent. mixture strength, benzene and alcohol show a T.I.C. unchanged from 15 per cent. strength upwards, below 15 per cent. the T.I.C. increases. Alcohol exhibits combustion in two stages, first decomposing to aldehyde, secondly at a higher temperature forming carbon dioxide. A rough concordance is observed between ignition temperatures of various substances (obtained by different workers in various ways) and the corresponding T.I.C.'s determined by the above method; in some cases the ignition temperature is below that of initial combustion. It is shown that the temperature due to compression attained by the mixture is above that of initial com-

bustion of the detonating portion of the fuel (i.e., the paraffins) even when a compression ratio of 3:1 is used; for nonane at 3·9:1 compression the heat due to compression exceeds the T.I.C. by 170°.

In support of the supposition of the formation of some detonating compound during initial combustion it is shown that by decreasing the time cycle by one-third the compression ratio can be increased 12 per cent. owing to the smaller time available for the formation of such compounds. Addition of 1 per cent. of iron carbonyl to undecane raised the T.I.C. of the latter from 200° to 350°. During the combustion of hexane and air at 500° ethylene and other unsaturated bodies were formed, the addition of organo metallic dopes inhibited the formation of these olefines, and reduced the rate of combustion. Metallic surfaces had only a slight effect on the T.I.C. of hexane and air, platinum black lowered it from 290° to 170°.

The presence of organo metallic "dopes" in alcohol-air mixture raised to 500° was found to cause increase of aldehyde formation, but the quantity formed is very much less than in paraffin-air mixtures under the same conditions. Aldehydes themselves were found to have little or no effect on changing the H.U.C.R. of petrol, in the majority of cases this was slightly raised by the addition of aldehydes. When added to petrol plus 5 per cent. aniline aldehydes caused a lowering of H.U.C.R. of the blend. The course of the oxidation of the paraffins is thought to be that dialkyl peroxides are first formed, the addition of a complete oxygen molecule being a change requiring less energy than the separation of the oxygen molecule to form hydroxyl compounds as postulated by previous workers. By bubbling the products of initial combustion from various substances through potassium iodide solution it was observed that ethers, paraffins and aldehydes formed peroxides on combustion while the products from alcohols, benzene aniline and phenol showed only a trace or complete absence of peroxides. Addition of anti-knock dopes to ethers, paraffins and aldehydes completely inhibited the formation of peroxides. Benzoyl peroxide in 4 per cent. concentration in petrol caused a lowering of H.U.C.R. of 15 per cent., other peroxides also produced marked decreases in H.U.C.R., the percentage decreases being approximately of the same order as that caused by the addition of amyl nitrite.

It is deduced that increase in compression ratio promotes the continuation of the fuel in form of liquid drops, conditions favourable to the formation of peroxides and to the sudden ignition of the liquid nuclei. Ultra-violet rays have been found also to produce peroxides in hexane-air mixtures. Formation of peroxides was also detected in an engine by suddenly switching off the ignition and immediately collecting the mixture ejected from the exhaust valves. By heating liquid undecane through which air was bubbled it was shown that peroxides are more easily formed in the presence of liquids than in exclusively vapour mixtures. In order to reproduce engine conditions as closely as possible a rapid flow of liquid drops of paraffin was maintained by an atomiser and compressed air through a combustion tube maintained at 516°, for comparative purposes a mixture of paraffin vapours and air was maintained. The tube with liquid drops gave a very strong reaction for peroxides, while that with vapour gave only very faint reactions. At 666° the vapour mixture burnt steadily, while that with drops gave explosions with flashes of flame reminiscent of the flash obtained by the ignition of a few grains of gunpowder. Addition of anti-knock dopes to the mixture with liquid drops extinguished the flame flashes, while the pro-knock material amyl nitrite produced the flame flashes at lower temperatures than with the fuel only. The action of metallic dopes is that of reducing agents thus preventing the formation of peroxides. W. N. H.

219. The Propagation of Flame in Mixtures of Methane and Air. Part V. The Movement of the Medium in which the Flame Travels. W. R. Chapman and R. V. Wheeler (*J. Chem. Soc.*, Jan., 1927). The paper is a continuation of that by the writers. *J. Chem. Soc.*, 1926, 2139.

Mixtures of methane and air containing 9·5–10 per cent. of the former were used. A brass tube 5 cms. diameter and 240 cms., long, was employed, this was fitted with a quartz window 40 cms. long, and 4 mm. wide, this could be placed at any point in the tube and the flame photographed in its travel. With both ends of the tube open and the mixture fired from one end, the flame speed accelerated for the first 80 cms. travel to 250 cms./sec., it then retarded until after 125 cms., it again accelerated to 575 cms./sec. after 200 cms. travel. With a restriction reducing the diameter of the tube to 1·5 cms at the ignition end the flame speed accelerated to 1030 cms./sec. after 120 cms. travel, it then retarded until after 170 cms. it again accelerated. The retardation in the former case was 25 per cent. as compared with 10 per cent. in the latter. With a similar restriction in the ignition end of the tube the effect of restrictions placed in the path of the flame was studied. After passing the restriction flame speed accelerated very suddenly. With a 2·5 cm. diameter restriction the acceleration was much less than with a 1·5 cm. restriction. When two restricting rings were present 1 cm. diameter, 40 cms. apart, the highest speed 30 cms. beyond the second restriction was obtained when the ignition end was restricted to 2·5 cms. diameter. Three restrictions in the flame path sometimes extinguished the flame.

With a restriction 2·5 cms. diameter at the opposite end from the ignition acceleration occurred for the first 80 cms. followed by slight retardation, followed by uniform movement.

With a closed tube fired at the open end uniform movement is attained; if restrictions are introduced these produce slight acceleration, followed by uniform movement. When fired from the closed end the flame was extinguished by a restriction unless this was of large diameter placed near the closed end.

Firing from the open end towards the closed end, accurate speed measurements show that the flame speed accelerates for half the path travelled, followed by slight retardation; this is in conformity with the view that the speed of "uniform movement" of a flame is compounded of (1) the normal rate of propagation of flame by conduction of heat, and (2) the initial movement of the unburnt mixture towards the closed end of the tube. Plotting log. diameter of tube against flame speed of uniform movement a straight line is obtained, thus $V=cD^k$, V=speed of uniform movement, D=diameter of tube, c, k are constants. W. N. H.

220. Research on Automobile Knock and Search for its Causes. G. Edgar. *Oil and Gas Journal*, Jan. 27, 1927, p. 33.

A number of questions involved in detonation in the internal-combustion engine are discussed. Theories put forward by various workers are as follows: (1) the influence of radiant energy, particularly in the infra red, is prominently concerned with knocking, (2) the ionisation caused by the flame causes knocking, (3) heat generated by adiabatic compression is responsible, (4) atoms of lead from the decomposition of lead tetraethyl ahead of the flame front oxidise and spread the reaction more evenly, (5) the rapid burning of drops of unvaporised liquid cause the detonation, (6) the electrical conductivity of the fuel determines its knock characteristics, (7) the metallic lead from the lead tetraethyl round off the sharp corners in the cylinder which would otherwise cause knocking. No complete explanation of all the phenomena

is offered by any of the above theories. Physical data is cited. The detonation wave formed in a mixture fired from the closed end of a tube open at one end travels about a thousand times as fast as the ordinary combustion wave. Detonation is found to produce characteristic changes in the spectrum of the combustion flame and anti-knocks influence markedly the character of the flame. Knocking is accompanied by abnormal temperatures and rates of pressure rise.

Chemical data is quoted. Of the nine heptanes no two have identical knock characteristics. The more easily a hydrocarbon knocks the lower is the temperature at which incipient oxidation occurs, anti-knocks, when mixed with hydrocarbons, appear to raise this temperature. A rough correlation exists between the ignition temperature of a fuel and its tendency to knock. The rate of combustion in an engine when knocking is greater than when running smoothly. W. N. H.

221. Measurement of Knock Characteristic of Gasoline in Terms of a Standard Fuel. Graham Edgar. *Ind. and Eng. Chem.*, Jan., 1927.

The absence is stressed of any standard fuel which could serve as a standard of knocking. All the well-known pure substances, such as alcohol and benzol, do not knock at all, and no commercial petrol can be accepted as a universal standard. The writer proposes that two pure obtainable paraffin hydrocarbons should serve as the standard fuels. Pure normal heptane may be obtained by the distillation of Jeffrey pine oil. This shows knocking tendencies worse than any commercial gasoline. On the other hand, 2, 4, 4-trimethyl pentane is obtainable in the laboratory by the treatment of tertiary butyl alcohol with sulphuric acid, and hydrogenating the resulting octane, and this paraffin is a relatively non-knocking fuel. Details of the preparation of this octane are given. By blending these two standards together in suitable proportions the knocking characteristic of any commercial gasoline could be precisely matched and expressed in terms of the standard fuels in the blend. W. N. H.

222. The Movement of Flame in Closed Vessels: Correlation with Development of Pressure. O. C. de C. Ellis and R. V. Wheeler. *J. Chem. Soc.*, Jan., 1927.

The writers study the relation between attainment of maximum pressure and the moment of complete inflammation within a spherical and cubical explosion vessel. The vessels were constructed with windows through which the progress of the flame could be studied photographically. A diaphragm indicator was employed for the recording of pressure. Mixtures of varying strengths of CO and air were used; it was found that for a spherical vessel with central ignition and a horizontal window the attainment of maximum pressure coincided with the arrival of the flame at the walls within less than half a millisecond for mixtures lying between 25 per cent and 65 per cent. CO; with mixtures outside that limit the flame front travels so slowly that its movement is affected by convection, so that it reaches the top of the vessel before the bottom; thus the pressure continued to rise after the flame had reached the boundary on the horizontal axis.

For a cubical vessel fitted with horizontal and diagonal windows and central ignition the attainment of maximum pressure for mixtures between 25 and 65 per cent., occurred after the flame had reached the corners made by two vertical sides of the cube, but before the flame reached the corners made by three sides of the cube. W. N. H.

223. The Movement of Flame in Closed Vessels; After-Burning. O. C. de C. Ellis and R. V. Wheeler. *J.C.S.*, Feb., 1927, 310—322.

When an explosive gaseous mixture is ignited at the centre of a spherical vessel the flame spreads concentrically outwards at a uniform velocity, when close to the walls the flame is retarded, velocity decreasing gradually. As soon as this second phase of the movement begins photographic records show a luminescence almost filling the sphere; this luminescence gradually contracts and disappears. In one experiment the flame reached the walls 15·7 millisecs. after ignition, the luminescence persisted 77·7 millisecs. after ignition. When the containing vessel is cylindrical the flame front rapidly becomes egg-shaped, luminescence begins to develop as soon as the flame touches the sides of the cylinders, and persists at least 40 millisecs. after the flame has reached the ends. This luminescence may be due (1) to re-association of dissociated molecules, (2) to dissociation of such molecules, (3) the completion of combustion of molecules of combustible gas that escaped burning whilst the flame was travelling. Re-association can only take place during a fall in temperature, whereas the luminescence begins long before any material cooling can take place. A reddish glow can often be observed after the flame has completely expired; this is non-active and may reasonably be thought to be due to re-association. The authors consider that dissociation cannot be the cause of the luminescence as dissociation would lead to a fall in temperature, whereas luminescent gas must be at a high temperature. They conclude that the phenomenon is due to after-burning, in the completion of combustion, under increased pressure, of molecules which escaped being burnt while the flame was travelling. The effect of diluents on the reacting gases was studied. Excess of either constituent in the mixture $2CO+O_2$ increased the duration of the original flame and shortened the duration of the after-burning. The after-burning is greatly decreased in mixtures of carbon monoxide and air when water vapour is present. Further series of experiments were made in which different diluent gases were used, nitrogen, argon and helium. A mixture $2CO+O_2+4X$ was studied (where X is the diluent) saturated with water vapour at various temperatures. Carbon monoxide as the diluent had the greatest effect on flame speeds in the mixture; with 6% of water vapour present mean flame speeds with the various diluents were as follows: CO, 565 cms/sec.; He, 410 cms/sec.; A, 230 cms/sec.; O_2, 400 cms/sec.; N_2, 170 cms/sec.; CO_2, 45 cms/sec. The duration of after-burning in the above mixtures with 6% water vapour present was found to be A 15 centisecs., He 12·7; O_2, 12·4; N_2 11·4; CO 8·7 centisecs. Flame temperatures in the argon and helium mixture were calculated to be 3529°, whereas the duration of after-burning was found to be definitely greater in the argon mixture compared with the helium mixtures; this disposes of any possibility of the luminescence being due to dissociation. The greater duration of after-burning in the argon mixture may be due, it is thought, to the greater actinic effect of the flame. This point is being examined further.

W. N. H.

224. The "Uniform Movement" of Flame in Mixtures of Hydrogen and Air. E. H. MacL. Georgeson and F. J. Hartwell. *J.C.S.*, Jan., 1927.

The movements of a flame were studied in mixtures of hydrogen and air contained in a horizontal tube closed at one end and fired from the open end. A quartz tube 90 cms. long and 2·4 cms. internal diameter was used and photographs were taken using a quartz lens and specially sensitive bromide paper. Mixtures between 20 and 50% hydrogen were used; outside that

range the flame was not sufficiently actinic to make records. It was found that speed fluctuations occurred during the first 26 cms., speed was reasonably uniform during the next 26 cms., it then decreased with vibrating movements over the last 26 cms. Speed of uniform movement is recorded as the speed over the distance 29—55 cms. from the open end of the tube; it reaches a maximum with the mixture 37·5% hydrogen. W. N. H.

225. Influence of an Anti-Knock Compound in a Gas-Ion Oxidation. S. C. Lind and Bardwell. *Ind. and Eng. Chem.*, Feb., 1927.

The rates of oxidation of a methane-air mixture under the influence of alpha-radiation were studied in the presence of varying concentrations of the anti-knock compound selenium di-ethyl. Radon was used as the source of radiation and the course of the oxidation was followed by observing the pressure of the reacting mixture. It was found that selenium diethyl exerted no appreciable change on the rate of reaction, the small rate of change observed was an acceleration in the presence of the anti-knock. W. N. H.

226. Studies of Combustion in the Gasoline Engine. W. G. Lovell, J. D. Coleman and T. A. Boyd. *Ind. and Eng. Chem.*, March, 1927, 373—378.

I. Determination of Rate of Burning by Chemical Analysis.

The authors recognise that examination of the exhaust products of an engine gives only an indirect view of the process of combustion which has occurred owing to the lapse of time, etc., after the completion of combustion. In order to obtain a closer insight a special poppet valve was fitted in the head of an air-cooled Delco-Light engine operating at 1,200 r.p.m. in a gasoline mixture giving maximum power output. This special valve was located 2·5 ins. from the sparking plug and was operated by a cam so that it opened for a period of two degrees crank revolution at any period of the explosion. Gaseous products were drawn with a well cooled water jacketed tube and were analysed in the usual manner. The progress of combustion was traced under knocking and non-knocking conditions. The successive samples drawn off were about 1 c.c. in volume, the cam therefore operated over a short period of time to give a sufficiently large sample. It was shown that under knocking conditions combustion was completed more rapidly than when running smoothly, being complete in 40° after ignition in the former case and in 53° in the latter. The addition of lead tetraethyl to a knocking fuel brought the time of combustion down to that of a non-knocking petrol. When the equilibrium constant of the reaction $H_2+CO_2=H_2O+CO$ was determined it was found that for smooth running it was 3·3 to 3·4 but increased to 3·8 or 4·0 under knocking conditions.

II. The Burning of Hydrogen and Carbon Monoxide.

Using the same engine with the special poppet valve described above, the authors used a mixture of hydrogen and carbon monoxide as fuel. An analysis of the products during combustion showed a steady decrease in oxygen, hydrogen and carbon monoxide, and a steady increase in the carbon dioxide content. The hydrogen was found to burn approximately twice as quickly as the carbon monoxide. Further experiments were run in the presence of the knock inducer ethyl nitrate and of lead tetraethyl and at a

high compression ratio. Assuming that the rate of disappearance of hydrogen follows the equation

$$\frac{d(H_2)}{dt} = k_1 (H_2)^n (O_2)$$

and that of carbon monoxide

$$\frac{d(CO)}{dt} = k_2 (CO)^n (O_2)$$

then

$$\frac{d(H_2)}{d(CO)} = \frac{k_1 (H_2)^n}{k_2 (CO)^n}$$

Integrating,

$$\frac{1}{(H_2)} = \frac{1}{(CO)} \frac{k_1}{k_2} + C.$$

Plotting reciprocal hydrogen concentration during combustion against reciprocal carbon monoxide concentration a straight line was obtained giving $\frac{k_1}{k_2} = 2{\cdot}35$. At higher compressions and in the presence of the dopes above mentioned $\frac{k_1}{k_2}$ was found = 2·2. It would appear that the two constituent gases burn simultaneously in the engine, and it is difficult to imagine a flame advancing across the combustion chamber, a boundary surface between completely burned and completely unburned gases. The authors consider the gases in the chamber to be practically homogeneous, the flame being broken up into a multitude of parts by the turbulence set up in the gases.

W. N. H.

227. "Pinking" in Internal Combustion Engines. G. B. Maxwell. *Fuel*, Mar., 1927, 121–130.

Various theories put forward by workers to account for pinking in the internal combustion engine are considered in detail. The author considers that the evidence is against the setting up of a true detonation wave within the confines of the cylinder. The "spontaneous ignition" theory, modified by Callendar's nuclear hypothesis is thought to account best for the facts. It is pointed out that the formation of organic peroxides in an engine cylinder has not yet been proved conclusively. Work is suggested on the combustion of fuel units.

W. N. H.

228. Analytical Measuring of Anti-Knock. J. Callowell and G. Egloff. *Oil and Gas J.*, 156, Jan. 27, 1927.

Further work is quoted on the lines of a previous paper (*Ind. and Eng. Chem.*), whereby the knock characteristics of a petrol may be calculated from its chemical analysis. Out of 19 petrols tested and analysed 75 per cent. checked with the engine test. Various factors are considered which may explain the discrepancies.

W. N. H.

229. Ignition of Gases. Part VI. Ignition by Flames. N. S. Walls and R. V. Wheeler. *J.C.S.*, Feb., 1927, 291–297.

Ignition of gases by means of a heated surface was not found to be instantaneous; ignition by means of a momentary source of heat of high temperature is more a phenomenon connected with the propagation of flame rather than its initiation. The relative ignitability of mixtures of various paraffins with air was determined; a vertical cylinder 5·5 cms. diameter, 50 cms. long was

fitted at the top with a brass cap in which a hole 1 cm. diameter was closed by a steel strip. A similar hole existed in the strip and by moving the latter the two holes could be made to coincide for a definite period. A fully aerated coal gas flame played vertically downwards on to the strip covering the hole in the brass cap; when the two holes coincided, a disc of flame of adjustable diameter was presented to the gaseous mixture in the explosion vessel. The flame was adjusted to give a disc 20 sq. mm. in area and exposures were made until the minimum required for combustion was found. Mixtures in air of methane, ethane, propane and pentane were studied. The composition of the most readily ignitable mixture in each instance corresponded fairly closely with that of the mixture in which the initial speed of propagation of flame is most rapid.

Combustible gas	Mixture in which speed of uniform movement of flame is fastest (Combustible gas %)	Relative speed of flame (cm./sec.)	Mixture most readily ignited by flame.	Relative duration of exposure of flame required (millisecs.)
Methane ..	9.65 ..	91 ..	9.8—10.0 ..	4.3
Ethane ..	6.05 ..	127 ..	6.8— 7.0 ..	2.7
Propane ..	4.45 ..	114 ..	4.8— 5.0 ..	3.2
Pentane ..	2.90 ..	115 ..	3.1— 3.3 ..	3.3

Thus the ease of ignition of an explosive mixture by a momentary source of heat is dependent essentially on the normal speed of propagation of flame in the mixture. A marked resemblance was noted between the ignition of paraffin-air mixtures by momentary flames and by electric sparks. A large area of flame made it more difficult to distinguish between the ignitabilities of two mixtures; a large volume of inductance sparks has the same effect.

W. N. H.

230. The Effect of Pressure on the Limits for the Propagation of Flame in Ether-Air Mixtures. A. G. White. *J.C.S.*, Feb., 1927, 498.

A wide range of ether-air mixtures can propagate flame horizontally; this range at ordinary pressures actually consists of two ranges which can be separated at lower pressures. By examining the ignitability of various ether-air mixtures at pressures between 758 mm. and 90 mm. of Hg the two ranges were determined; results were as follows.

Original pressure of ether-air mixture (mm. Hg).	Range of ether-air (% ether) that would propagate flame horizontally.
758	1.88— 34
660	1.88— 35
590	1.87— 35
500	1.88—9.25 and 13—33
440	1.88—9.25 and 15—31
400	1.88—8.4 and 19—27
360	1.89—8.1 No cool flame detected
300	1.89—7.5
240	1.98—7.5
190	2.05—6.9
90	2.33—6.1

Ignition was effected by either a spark from a 20 in. coil or an electrically heated helix of Pt wire; the latter was used when cool flames were dealt with. W. N. H.

See also Abstracts Nos. 122 and 137.

Cracking.

231. Corrosion in Cracking Equipment. G. Egloff and J. C. Morrell. *Oil and Gas Journal*, 1927, **25**, 140.

Corrosion in cracking stills is due mainly to hydrogen sulphide, the amount of which produced during cracking bears no relation to the quantity of sulphur present in the cracking stock. There will shortly be cracked on the Pacific coast alone over 100,000 barrels of high sulphur-content oil. This will contain about 650,000 lb. of sulphur and would necessitate the use of 2,000,000 lb. of copper oxide daily to remove; and the desulphurisation would be incomplete. Thus, instead of desulphurising cracking stock, plant must be built to withstand corrosion due to hydrogen sulphide.

Corrosion brought about by hydrogen chloride occurs only in the condensing systems, *e.g.*, in vapour lines from dephlegmator, condenser and receiver and can be avoided by neutralisation with *e.g.* ammonia.

Electrolytic corrosion is exhibited in the condenser system in the face of flanges, on tubes and gaskets and can be remedied by using gaskets which are unaffected by vapours and having low electromotive potential difference between gasket and tube.

Elementary sulphur is responsible for corrosion, particularly where the sulphur has condensed and is in the molten state. There is evidence also that sulphur corrodes reaction chambers below the liquid level line.

Tests over periods of 20 days, in which 17,000 barrels of California oil containing 1 per cent. of sulphur were cracked with various metals suspended in the vapour zone, showed aluminium to be the most, and copper the least, resistant to corrosion. Thus, aluminium lost ·004 g. in weight per sq. in. of exposed surface, duraloy 0·01 g., steel 1·19 g., monel metal 3·85 g., copper being entirely acted upon.

The corrosion of pressure still equipment occurs principally in heating tubes, return bends, plugs, pipe connections in hot oil pumps, hot oil pumps and pyrometer wells in what is primarily the liquid zone, and in the vapour lines, reaction chamber, dephlegmator and pyrometer wells in the liquid-vapour and vapour zones. The life of mild steel tubes subjected to the highest temperature conditions is about two months with a stock containing 1 per cent. of sulphur. A 15 per cent. chrome iron tube resists corrosion remarkably well: such tubes in service for seven months show no marked corrosion and are still in service. Calorised tubes give inconsistent results, sometimes standing up well and sometimes failing as rapidly as mild steel tubes. In regard to return bends, the use of alloys like chrome iron, chrome nickel iron and chromium plating are advocated. Plugs of chrome iron are apt to "freeze," resulting in difficulty in removing the plug from the return bends. Chromium plating is effective provided the plating is done well: also the difference in coefficient of expansion between plating and metal base must be small to prevent peeling.

The reaction chambers in some equipment corrodes at the rate of $\frac{1}{16}$ in. per month. A thin layer of chrome iron may be applied or the chamber may be lined with boiler or chrome-iron plates. Lining with aluminium has not been satisfactory owing to its low softening point and high coefficient of expansion, which produces a creep effect. Electroplating with chromium

has also given good results. The chamber may also be coated with, e.g., water glass, graphite, etc., but no definite commercial results are available. The vapour line is a sensitive element in equipment. The use of chrome iron, either completely or as plating is effective. Corrosion in the dephlegmator is markedly less than in hotter portions of plant and may be inhibited by using baffle plates of aluminium, aluminium alloys or chrome iron alloys, the first-named being inapplicable if alkalis are injected. The reflux conduit problems are similar to those arising in vapour lines. Corrosion becomes markedly less from the vapour line to condenser coil and pressure distillate receiving drum and gives little trouble except from hydrochloric acid. H. G. S.

232. The Cracking of Petroleum. Effects of the Corona Discharge. J. J. Jakosky, U.S. Bureau of Mines, Tech. Paper 375. *Petr. Times*, 1927, 17, 302.

When used in cracking oils, the corona discharge may have chemical and mechanical or precipitating effects, the latter being the more important. Its action is to precipitate the particles of mist against the hot walls of the cracking tube. The use of a corona discharge at the exit line of a cracking still is suggested since it would prevent heavier fractions from being carried into the condenser, reduce the load on the condensing system and increase the efficiency of the cracking still. H. G. S.

233. New Cracking Process in Operation. C. O. Willson. *Oil and Gas Journal*, 1927, 25, 158.

The Angus refinery of the Kent Middleton Refining Co. is operating the Richey process. The plant handles between 600 and 700 barrels of stock daily, about half of which is fresh gas oil, the yields being 30 per cent. gasoline and 50 per cent. re-cycle stock. The plant consists of two heat exchangers, a tube still divided into a preheater and soaking coils, three reboilers and a bubble tower. The heat exchangers consist of 2 in. boiler tubing inside 4 in., the first having 16 lengths of 20 ft. and the second 4 lengths of 16 ft. and 4 lengths of 20 ft. coils. The charge, a 50—50 mixture of fresh gas oil and recycling stock, flows through the shell of the first preheater in counter-current to hot gas oil leaving the bubble tower and becomes heated to 200° F. It next passes through the second preheater counter to the hot oil from the soaking coil, becoming heated to 525° F. and simultaneously cooling the hot, partially cracked oil from 925° F. to 760° or 780° F. Thence the charge, under 600 lb. pressure, enters the tube still consisting of 77 lengths of 21 ft. tubing of 2½ in. internal diameter, in which it is heated to an unstated maximum temperature. The soaking coil, 22 lengths of 21 ft. tubing, now maintains the oil at a constant temperature until it enters the second preheater, which it leaves at 760° to 780° F. to pass into the reboilers. The latter take the place of the conventional reactor or vaporiser and consist of 3 ft. by 24 ft. cylinders, inside which are 8 lengths of 1½ in. tubing. The hot oil traverses these tubes in parallel, enters a header at the other end and is then made to pass through the shells of the reboilers in series, the pressure being dropped from 600 lb. to atmospheric. The vapours are taken through a 4 ft. by 30 ft. bubble tower with 18 sections, a certain amount of fresh gas oil being charged at the top to assist dephlegmation. The refluxed hot gas oil leaving the tower flows through the first heat exchanger whilst the gasoline leaves at the top andis condensed. Various suggested improvements in the plant are described. H. G. S.

234. Secure Cracking in Reducing Still. C. O. Willson. *Oil and Gas J.*, 1927, **25**, 32.

The Kellogg pipe still of the Panhandle Refining Co. is designed to operate with crude oil as a complete skimming plant and reducing unit or as a reducing unit operating with topped crude. It is being used for the latter purpose, giving substantial yields of cracked spirit with the kerosene and gas-oil distillates, the last named constituting charging stock for two Dubbs units. The partial cracking effect obtained reduces the amount of material to be handled in the cracking units. The crude oil passes through six shell stills in the conventional manner, gasoline and naphtha being removed. The hot residue (sp. gr. ·9) is then charged through pumps at about 274° C. direct to the pipe still, which consists of 4 in. (O.D.) tubing divided into preheater (2,640 ft.), cracking tube (1,325 ft.) and soaking tube (1,320 ft.). The cracking coil is placed in the combustion chamber and 70 per cent. of the cracking takes place there at a temperature of about 450° C., the temperature in the soaking coil being about 5 per cent. higher and the pressure approximately 175 lb. The cracked product now discharges into the centre of a 6 ft. by 32 ft. vertical vaporiser, the lower half of which is equipped with six cast-iron baffles and the upper half filled with 3 in. chemical (Vento) tile, the pressure being reduced to 10 lb. per sq. in. About 77 to 78 per cent. of the charge passes out as overhead products, the residue being taken from the bottom as a commercial grade of fuel oil. The overhead products leave the vaporiser at about 390° C. and enter a 7 ft. by 35 ft. bubble tower containing 12 plates, a Ross reflux condenser being superimposed on the tower. The gas oil is refluxed and taken from the bottom, the vapours being conducted into a second tower (6 ft. by 47 ft.) with 18 bubble decks. The final overhead constitutes gasoline, the residue draw-off being kerosene. A system of heat interchange is described. The rated capacity of the unit is 2,500 barrels daily, with yields of 10 per cent. gasoline, 14 per cent. kerosene and 55 per cent. gas oil, the remainder being ·972 to ·986 fuel oil. H. G. S.

235. Pressure Still Heating Furnace. J. E. Bell. U.S.P. 1,617,297, 1927. Appl., April 1, 1924.

The overheating of cracking tubes is prevented by mixing cooler air or gases with the hot products of combustion from the furnace. The cooling medium may be preheated to the temperature of the gases leaving the flue. H. G. S.

236. Improved Process for Obtaining Low Boiling Hydrocarbons and Other Products from Distillation Products Derived from Bituminous Materials. Braunkohlen-Produkti A.G., K. Bube and E. Erlenbach. E.P. 265,375, 1926.

The invention comprises a process for cracking products poor in hydrogen and derived from bituminous raw materials such as tar, shale oil, soft asphalt or crude creosote. The materials specified are mixed with heavy hydrocarbons rich in hydrogen, *e.g.*, gas-oil, the mixture distilled and the vapours heated at atmospheric pressure to above 400° C. Treatment of the vapours may take place in presence of catalysts, the best results being given by aluminium, magnesium and alloys containing a high proportion of these metals. Iron, copper, nickel, etc., may be used, but their action becomes neutralised by the formation of sulphides. As an example, 10,000 kg. of generator tar were distilled in presence of 2,500 kg. of a mid-Continental gas-oil and the vapours passed through a heating space filled with aluminium turnings and heated externally between 450° and 650° C. The vapours from

the contact chamber were refluxed, the condensate being returned to the still. The products were: 2,000 kg. of light oil to 150° C.; 1,900 kg. of light oil to 210° C.; 3,000 kg. of light oil to 290° C.; 1,300 cm. of gas and 3,000 kg. of asphalt free from coke. The factions 150°–290° C. contained 16 per cent. of cresols. H. G. S.

237. Process of Converting Oils and Apparatus Therefor. J. C. Clancy. U.S.P. 1,620,075, 1927. Appl., April 6, 1924.

The process is based upon the catalytic effect of aluminium chloride in the cracking of oils, tars, etc., and is rendered continuous by causing interaction to take place in the presence of a molten body containing zinc chloride, preferably a mixture of zinc and sodium chlorides. The apparatus described consists of a vertical reaction chamber, filled with Raschig rings of nickel, and surmounted by a hopper containing a molten mixture of zinc and sodium chlorides. The oil to be cracked, and containing aluminium chloride, is made to flow in a downward path, with the mixed molten chlorides, through the chamber in which it is subjected to thermal decomposition. The vapours of cracked oil and aluminium chloride are taken to a scrubbing tower, where they meet a stream of incoming oil which reabsorbs the condensed aluminium chloride, thus only sufficient of the latter to replace losses need be added. The molten chlorides and coke are withdrawn from the bottom of the chamber, the latter filtered off and the former used again. Hydrogen may be admitted into the reaction chamber. H. G. S.

238. Process of Cracking or Treating Oils and Other Similar Hydrocarbons. H. T. Darlington and R. M. Steffen. U.S.P. 1,614,660, 1927. Appl., June 2, 1923.

The process consists in subjecting oil to cracking conditions in presence of a gel composed of a natural colloidal cracking agent having catalytic properties. The gel specially described consists of bentonite and water, prepared by allowing the mineral to swell in water, the resulting product being dispersed through the material to be cracked by grinding or otherwise. The employment of such a gel has advantages over the use of, say, anhydrous aluminium chloride in that the oil need not be dehydrated prior to cracking. H. G. S.

239. Improvements in and Relating to the Conversion of Heavy into Lighter Hydrocarbons. Deutsche Erdöl A.G. E.P. 244,107, 1925.

The main object of the process is to preheat the oil, under pressure, to cracking temperature and then to allow it to remain in a converter, preferably horizontal, for a sufficient length of time for the required degree of conversion to take place. The converter is externally heated independently of the preheater, enough heat being supplied to maintain the oil at the desired temperature. The product now enters a separator at reduced pressure, the vapours being refluxed and the condensate recycled. H. G. S.

240. Method and Apparatus for Distilling Liquids. W. F. Downs. U.S.P. 1,616,079, 1927. Appl., Dec. 24, 1921.

The distillation and/or cracking of oils is effected by applying the highest heating effect to a rising column of oil of narrow cross-section and then spreading out the liquid in a thin film above the normal surface of the body of oil so as to facilitate the escape of the lighter products. The apparatus consists of a still containing a vertical tube, which is closed to the entry of

oil at both ends and the walls of which are heated by any known means. Concentric with this tube is a second one, open at both ends and comprised of a number of telescopic sections, the upper one of which is supported above the level of the oil by means of an annular, umbrella-shaped float. The lower end of the outer tube is provided with a dome, which extends laterally a short distance above the bottom of the still and serves as a collector and guides the oil into the annular space between the two tubes. The heated oil at the bottom of the still passes upwards between the tubes, is cracked in its passage and then spreads out over the float, the vapours being withdrawn from the still and the unvaporised portion falling back into the oil. The telescopic form of the outer of the two tubes keeps the float resting on the surface of the oil. H. G. S.

241. Process of Cracking Petroleum Oil. G. Egloff. U.S.P. 1,619,921, 1927. Appl., Dec. 13, 1920, and June 9, 1926.

In a plant consisting of cracking tubes, expansion chamber and dephlegmator, the reflux is made to enter the transfer line immediately before the expansion chamber. A differential pressure may be maintained on the various parts of the plant, in which case a pump is installed to force the refluxed oil from the dephlegmator into the transfer line. H. G. S.

242. Apparatus for Cracking Oil. G. Egloff and H. P. Benner. U.S.P. 1,617,619, 1927. Appl., Aug. 21, 1920, and June 6, 1926.

The apparatus consists of a nest of cracking tubes connected by a pair of headers and heated in a furnace, a vertical expansion chamber, dephlegmator, condensers and receivers. The oil, after cracking in the tubes, enters at the top of the expansion chamber and by means of a partition therein is made to pass to the bottom of the chamber and then upwardly into the dephlegmator. Carbonaceous matter which settles in the separating chamber is constantly withdrawn by means of a rotary valve, whilst the reflux from the dephlegmator is directed into the cracking tubes. The arrangement of valves allows pressure to be maintained to the exit of the condenser or otherwise as desired. H. G. S.

243. Apparatus for Cracking Oil. G. Egloff and H. P. Benner. U.S.P. 1,619,922, 1927. Appl., Sept. 1, 1920 and Sept. 2, 1926.

The apparatus consists of two cylindrical horizontal stills placed one above the other in a furnace and so constructed that the major portion of each still can be caused to rotate, one end of each being stationary. The oil to be cracked is pumped into the lower still, the vapours evolved therein being taken by means of a pipe through the stationary ends into the lower portion of the upper still. The vapours from the latter are then passed into a dephlegmator, the condensate being returned to the upper portion of the lower still for further treatment and the uncondensed product conducted through a condenser to storage. Means are also provided for the withdrawal of heavy residues from each still. H. G. S.

244. Improved Process and Apparatus for Distilling or Cracking Hydrocarbons and Purifying the Vapours. The Gray Processes Corporation and T. T. Gray. E.P. 249,871, 1926.

The process relates to the refining of petroleum distillates in the vapour phase by means of adsorbent materials and is an improvement on E.P. 222,481. The main objects of the invention are the elimination of gum from the body of a catalyst and the facilitation of the discharge of the latter from the plant. The former object is achieved by washing the adsorbent

with a suitable solvent during the passage of vapours through the adsorbent. The solvent preferably used is a portion of the vapours condensed either in the catalyst itself or condensed after passage through the catalyst and returned thereto. Alternatively, steam may be employed as a cleansing agent or the vapours may be washed with a liquid capable of dissolving high-boiling substances, such scrubbing being effected subsequently to the passage of the vapours through the catalyst. Several forms of preferred apparatus are described, the vapours being passed either upwardly or downwardly through the catalyst and means to charge and discharge the catalyst also described. H. G. S.

245. Apparatus for Treating Petroleum Oil. H. J. Halle. U.S.P. 1,619,929, 1927. Appl., Sept. 1, 1920, and Sept. 18, 1926.

The objects of the invention are the reduction in fuel costs and the prevention of overheating of cracking tubes. The latter are built up of two concentric tubes, the oil to be treated flowing through the annular space between the two coils and hot products of combustion from the furnace through the centre tube. H. G. S.

246. Oil Cracking Still. E. C. Herthel. U.S.P. 1,615,583, 1927. Appl., Nov. 28, 1921.

An improved method of heating is claimed in an apparatus in which oil is made to flow through pipes in counter-current to hot products of combustion from a furnace. The tubes most remote from the entering hot gases are provided with metallic elements which increase their surface area and thus increase their heat absorption efficiency. H. G. S.

247. Process and Apparatus for Treating Oils. L. C. Huff. U.S.P. 1,619,977, 1927. Appl., July 3, 1924.

The process of and apparatus for cracking oil has for its particular object improvements in the arrangement and position of the heating coils. The process consists in forcing the oil under pressure in a plurality of independent streams through a furnace, and increasing the velocity of the oil approaching the point of highest heat by combining the oil streams into a less number of streams. The deposition of carbon in the hottest tubes is reduced to a minimum by the high velocity imparted to the oil in that portion of the plant. H. G. S.

248. Process and Apparatus for the Purification and Hydrogenation of Liquid Hydrocarbons. C. D. Maze. E.P. 263,381, 1926.

The simultaneous desulphurisation and hydrogenation of oils is effected by passing the vapours, together with steam, at substantially atmospheric pressure over divided metals capable of decomposing water at the temperature of operation, *i.e.*, 350° to 450° C. The metals available are iron, nickel, copper, cobalt, zinc and cadmium or their mixtures and in case highly sulphurous oils are to be treated, vanadium or tungsten may be added to the extent of 5 per cent. of the divided metal. The quantity of steam used is approximately twice that of the oil; and regeneration of the spent metals is effected by periodically increasing the proportion of steam to oil. The divided metal may be replaced by a molten bath of an easily oxidisable metal such as lead, tin, zinc, copper, antimony, bismuth or aluminium. The apparatus may comprise an externally heated retort containing a conical bell, the mixture of steam and oil vapours entering the top of the bell and being made to pass through the divided or molten metal placed in the

annular space between the bell and the retort. Alternatively, the retort and its contents are heated internally by means of a flame in a combustion chamber, the hot gases of combustion accompanying the steam and oil vapours downwardly through the divided metal. H. G. S.

249. Conversion of Hydrocarbon Liquids. A. J. Paris, Junr. U.S.P. 1,614,930, 1927. Appl., May 14, 1924.

The process consists essentially in distilling crudes, distillates or residues and subjecting fractions of narrow boiling range to cracking conditions depending upon the particular fraction and the product desired. A maximum boiling range of 100° F. is stipulated, though a range of 25° F. is preferred. The vapours from the still may either be condensed and collected in small fractions before passage through the convertor or they may travel direct to the converter without being condensed. The capacity of the lines from still to cracker is restricted to from less than 2 per cent. to less than 25 per cent. of the capacity of the normal charge of the preliminary still.

H. G. S.

250. Cracking of Hydrocarbon Oils. C. L. Parmelee. U.S.P. 1,613,718, 1927. Appl., Oct. 8, 1924.

The process is an improvement on U.S.P. 1,283,300, 1918, and is designed to prevent or reduce deposition of carbon in the cracking tubes, to improve the separation of light products from the recycling stock and to reduce contamination of the raw stock with carbon or tarry matter produced in the operation. These objects are effected by the provision of a separating chamber, surmounted by a column and connected to a supply chamber. The raw oil enters the top of the column and passes over baffles in counter-current to the vapours from the separating chamber, being then directed, together with the overflowing clarified oil from the separator into the supply chamber and thence through a cracking coil into the separating chamber. Deposited carbon is removed as required from the latter. H. G. S.

251. Process for Converting High Boiling Oils into Low Boiling Oils. D. L. Thomas. U.S.P. 1,611,615. Dec. 21, 1926.

In this process, a still, designed on the Venturi tube principle, is composed of converging and diverging sections connected by a throat piece of special construction. An apparatus of this kind has the property of converting pressure energy directly into velocity energy with a corresponding diminution at the point of highest velocity and further reconverting this kinetic energy into potential or pressure energy with little pressure loss. The upper converging chamber is externally heated and serves as a vaporising chamber for the oil, which is supplied in the form of a fine spray. The oil is preheated before spraying to its boiling point so that only the latent heat of vaporisation need be supplied.

The lower diverging chamber acts as a retarding section for reconverting the velocity energy back into pressure. It is similar in construction to the upper chamber and is connected to a "digester" consisting of a relatively large diameter cylinder filled with short lengths of iron tubing.

The throat piece connecting the upper and lower chambers is formed with downwardly inclined holes in its walls and is enclosed in a casing. Gases obtained in the process are heated externally and passed into the oil in this section to promote cracking of the oil vapours, usually at a temperature of 500° to 600° C. for gasoline or 600° to 700° C. for the production of aromatic compounds.

It appears that two reactions are involved in the formation of light hydrocarbons. The first involves the decomposition of the heavy molecules into saturated and unsaturated hydrocarbons of lower molecular weight with the production of hydrogen and consequent increase in volume. Diminished pressure assists and accelerates this stage. The second step, however, requires condensation and hydrogenation of the unsaturated compounds, and pressure favours this reaction. By means of the Venturi tube and digester it is claimed that these conditions are attained.

R. P.

252. Process for Converting or Cracking Hydrocarbon Oils. W. E. Trent. U.S.P. 1,619,896, 1927. Appl., Sept. 27, 1924.

The cracking stock is passed through a heat exchanger under a vacuum so that substantial vaporisation occurs. The vapours are then highly compressed isothermally and are returned through the heat exchanger in countercurrent to, but out of contact with, the crude oil or cracking stock. The compressor may be cooled to any desired extent by diverting a portion of the raw stock through a jacket surrounding the compressor, the oil so heated being then taken through the heat exchanger.

H. G. S.

See also Abstracts Nos. 275 and 276.

Oil Field Technology.

253. The Gas-Lift System in Texas. E. O. Bennett and K. C. Sclater. *Petr. Times*, 1927, 17, 427, pp. 543-544.

In the Panhandle Field of Texas a gas-lift well is started by admitting gas to the tubing and allowing it to pass up through the oil between the tubing and the casing for about one hour. The aeration of the column is then sufficient to cause the mixture to flow. When the flow starts the direction of the gas is reversed to flow down through the annular space and the tubing opened to flow. By this method, wells from 3,000 feet have been started on a maximum pressure of 250 lb., whereas 600 lb. is often insufficient to start similar wells through tubing.

Another method, called "super-flushing," consists of starting the gas through the tubing as described above. After flow has been started from the annular space, a large quantity of gas is suddenly released through the tubing, expelling all the aerated fluid. The direction of flow is then reversed and flow started through the tubing. A well requiring 180 lb. normal working pressure has been started by this method on a maximum of 230 lb.

In Panhandle the temperature of the oil formation is only 85° F., and as the oil congeals to a solid mass at about 60° F., this allows only a 25° F. drop in raising the oil to the surface. Since isothermal expansion of the gas injected, and the natural gas in the well cannot be obtained, the refrigerating effect of the gas expansion causes deposition of paraffin, and the application of heat is only partially successful. A device has been designed, known as a "flow devil" and consisting of two annular collars on a mandrel, the upper end of which has a standard pin joint. One cutter at the bottom of the tool is sufficient to remove the paraffin from the casing walls. The scraper is lowered on a sinker bar and short stroke jars.

The surplus gas over the amount required for return to the well is compressed and used for fuel purposes on the lease.

When the oil-bearing strata is above, and in contact with, the water-bearing formation, and wells have been producing by heavy swabbing or with large

gas factors, the pressure in the upper gas sand has been reduced near the well and the water breaks through, cutting off the oil. Such conditions can be remedied by the use of gas-lift under back pressure. The gas is pumped down between the casing and the tubing and the oil produced through the tubing, the bottom of which is raised to a point where the fluid head between it and the water surface, plus the head necessary to flow the oil, is sufficient to prevent the water coming up through the oil.

The increased gas factor method permits a larger production than otherwise, and by passing the gas through an absorption plant, additional gasoline is obtained. G. S.

254. Standardising the Construction of Concrete Derrick Corners. Foster. *Oil and Gas Journal*, March 3, 1927.

The question of the soil on which the derrick is to be erected is first entered into and a table of the safe loads per square foot for various types of soil is given. After this the necessary allowance for wind pressure on the derrick itself is considered.

Additional strength per surface area of concrete is given by embedding the corners in the soil, as the surface is seldom so compact as the slightly underlying layers. Only in running soils are forms required, provided the sides of the excavation are perpendicular. After the initial hardening has taken place it is not necessary to delay the erection of the derrick provided measures are taken to protect the material from excessive cold and too rapid evaporation of the water present. A. R. S.

255. Principles of Fluid Delivery from Oil and Gas Reservoirs. S. C. Herold. *Oil and Gas Journal*, 25, 37.

If the law of equal expectation holds for wells in the same field it is possible to obtain a law governing the spacing of the wells. The effect of varying back pressure on the volume control of the well and on its radius of drainage influence is first discussed, and the state of the well at partial exhaustion is described. The writer next describes the effect of well spacing on the percentage recovery and gives a curve showing the variation, the well space WS being expressed in terms of R, the radius of any well in the field. The effect of making WS less than 2R, and less than R is also given, and from observations of the effect of neighbouring wells upon the particular one under consideration it is possible to calculate R. P. D.

256. Treating Emulsion in the Field. *Oil News*, Feb. 12, 1927.

The plant consists essentially of a large capacity cylindrical tank, set in the ground. A separate conical electrode is bolted to the tank near the bottom, and the oil enters at the apex of the cone. The second or live electrode is likewise conical, but instead of being a flat surface consists of iron sheets arranged concentrically within the cone. This electrode is suspended by an insulated shaft which passes through a stuffing box at the top of the tank. A walking beam attached to the shaft is actuated by motor to impart a churn-like motion to the live electrode, thus preventing shorting of the current through bodies of free water.

The live electrode is connected to the high side of a transformer, and an automatic circuit breaker keeps the circuit broken unless the tank is completely filled. The oil is heated before being delivered to the treater, and as the point of entrance is in the electric field treating begins at once. The

separated water is drawn off by a goose neck, while the water-free oil is discharged at the top of the tank.

The installation cost of this plant is low, while the overall cost of operating is probably lower than in any other electric treater. A. R. S.

257. Hard Metallic Materials for Drilling Tools. *Pet. Times*, Feb. 12, 1927.

Steels, even special chrome tungsten steels, are only suitable for the cutting parts of drills where the temperature of drilling does not rise to 600° C. Until recently diamond drills were used where higher temperatures than this were likely to be reached, but on account of the scarcity and high price of these, other drilling materials had to be developed. These are of metallic materials, and while at ordinary temperatures none of them is more efficient than high speed steel, they reach their maximum drilling efficiency at 600–800° C., while the wide range of products available makes them suitable for all drilling work.

These compounds cannot be wrought, but must be cast into the desired shape. Their softening points vary from 1,000–3,000° C., and their hardnesses from 6-9·8 on Moh's scale. In cooling from their softening points they regain their hardness, in marked contrast to steels.

The present prices of these materials are high, although not sufficiently so to materially affect the advantage of their use. A. R. S.

258. The Petroleum Oils of Grozny. A. Sachanen-Sachonov. *Petroleum*, 1926, 22, 1240—1244.

Crude oil rich in wax is found in the deeper layers of the new oilfield. It has *d* 0·840, solidification pt. 15° C., greatly affected by hysteresis, content of wax 7 per cent., of m.pt. 53—54° C., sulphur content 0·25 per cent. The yield of benzine is 23·31 per cent., and of kerosene 13·31 per cent. The residue after the removal of lubricating oils, contains 90% of paraffin wax of m.pt. 75° C. Oil poor in wax is found in the Solenaja Balka field, has *d* 0·840 and solidification pt. — 10° C. It yields 27·79 per cent. of benzine and 12·54 per cent. of kerosene. Crude oil free from wax is found in almost all horizons of the old field and in the highest layer of the new field. Its *d* is 0·850–·860, but on arrival at the refineries its *d* is 0·870 owing to weathering, the wells being slow producers. Its solidification pt. is below —20° C. It contains some 0·1 per cent. to 0·5 per cent. of wax, though named wax-free, of m.pt. 59—63° C. The sulphur content is 0·2—0·3 per cent. The yield of benzine is 28·53 per cent. and of kerosene 12·55 per cent. The residue from this oil contains 18·9 per cent. of asphaltenes. This oil is of asphalt base, the oils rich in wax and poor in wax being considered of mixed base. The natural gases of Grozny have a temperature of 80—90°, and are generally of high *d*, 1·30—1·40, and seldom below 1·0. They yield 1 kg. of benzine per cb. m., consisting of 30—40 per cent. of condensable hydrocarbons and 60—70 per cent. of methane, ethane and propane. H. M.

259. Process for Conditioning Crude Oil Emulsions. C. C. Averill, Assr. to W. S. Barnickel and Co. U.S.P., 1,617,737. Feb. 15, 1927.

The process consists in adding water to the emulsion, emulsifying the mixture, and adding a chemical demulsifier, when the emulsion is readily broken. S. W. C.

260. Process for Treating Petroleum Emulsions. C. C. Averill, Assr. to W. S. Barnickel and Co. U.S.P., 1,617,738. Feb. 15, 1927.

The process consists in first emulsifying the emulsion before treating it with a chemical demulsifier. S. W. C.

261. Process for Breaking Water-in-Oil Emulsions. C. C. Averill, Assr. to W. S. Barnickel and Co. U.S.P., 1,617,739. Feb. 15, 1927.

The process refers to stubborn emulsions such as tank bottoms. It consists in adding to the emulsion water at least equal in volume to the amount of emulsion, then a chemical demulsifier and emulsifying this mixture. The mixture is then raised to 160° F. to 240° F. and allowed to stand, when the oil separates out. S. W. C.

262. Process for Recovering the Oil from Mineral Oil Emulsions. H. N. Doss, Assr. to N. A. Hallaner, N.Y. U.S.P. 1,617,201. Feb. 8, 1927.

The emulsions (e.g., B.S. or roily oils) are mixed with cellulose material, prepared by treating cellulose with a concentrated aqueous solution of caustic soda, potash, or ammonium hydroxide, by agitation until the separation of the oil and foreign matter has taken place. The mass is then left to settle, when the oil will be found in a layer at the top over a layer of water and foreign matter and at the bottom the cellulose material. The oil and water may be drawn off and the cellulose material used again. About 1 to 5 per cent. by volume of the material is sufficient to break up the emulsions commonly met with. S. W. C.

See also Abstract No. 121.

Petroleum Geology.

263. Age of the Oil in the Miocene Shales of the Ventura District, California. L. D. Cartwright, Jr. Amer. Assoc. of Petr. Geologists, Bull., Jan., 1927.

Having noted the occurrence of pebbles of burnt shale in beds of the Fernando group (Pliocene) of the Ventura quadrangle, California, it is suggested that petroleum must have been formed in the lower Miocene shales before the deposition of the Fernando.

The occurrence of burnt shale outcrops is familiar to geologists in this country, and if one accepts the explanation that the metamorphism is due to the burning of accumulated oil, at or close to the surface, the occurrence of these burnt shale fragments in the younger formation shows that the older shales contained oil before the conglomerate beds were laid down. Contact relationships between the Miocene and the Fernando beds indicate that the former were only slightly deformed here before the deposition of the Fernando. Hence it would appear that the forming of petroleum in the Miocene beds was not an accompaniment, necessarily, of the diastrophism recorded in their complex structures. J. E. M. H.

264. Review of the Oil and Gas Prospects of Australia. F. G. Clapp. Bull. of Amer. Assoc. of Petr. Geol., Jan., 1927.

As a general statement, Western Australia and Tasmania are considered unfavourable, South Australia and Victoria largely so; but a possibility of oil or gas may exist somewhere in New South Wales or Queensland.

Vast areas have been eliminated from consideration on account of remote age, metamorphism, and other factors. Other great regions have been rejected on the basis of explorations by the writer and other geologists in search of oil.

All work has been of a reconnaissance nature, except where areal mapping in detail has been done with reference to coal and metal mining.

This paper is merely a review of the available knowledge, calling attention to areas and fundamental conditions believed to be important in a broad consideration of oil prospects. J. E. M. H.

265. "Our Mobile Earth." Prof. R. A. Daly. *Nature*, 19.3.27.

The author opens up his subject by numerous examples of earthquakes, their localisation in the tertiary mountain belts being explained as due to up-and-down and sideway adjustments of already folded masses.

Seismograms are next explained and the three kinds of earthquake waves distinguishable in these records.

The Continents are claimed to be great discontinuous masses of aggregate granite composition, and that they float in iceberg fashion with foundations immersed in crystalline basalt; below this he suggests there is a circum-mundane layer of glassy basalt.

A chapter follows on volcanic action, with much stress laid upon Kilauea in general and gas flexing in particular.

Recent phenomena of emergence and submergence are next considered, attempts being made to disentangle earth and sea movements respectively. Thus, a low raised beach which the author has traced along much of the shores of the Atlantic Ocean and the Pacific Ocean is attributed to a Neolithic withdrawal of water to augment some still existent ice-sheet, whilst isostatic earth movement in connection with ice-load is considered important for the understanding of the raised sea-beaches of glaciated lands.

As regards the mountains of the globe Prof. Daly rejects the earth-contraction theory of their origin, adopting instead the Continental drift hypothesis. His statement is as follows: (1) Continental drift is of the nature of a gigantic landslip. (2) The glassy substratum makes slipping easy. (3) The slipping continents crumple marginal geosynclines. (4) The glassy substratum allows of subsidence of crust-blocks beneath crumpling geosynclines, and the fusion and expansion of these blocks causes the eventual elevation of mountain chains.

Daly assumes a lag between crumpling and elevation; but in Europe evidence seems to point to their contemporaneity. For instance, the tertiary Flysch and Molasse of Switzerland derived most of their material from already elevated Alps that were actually travelling. The travel was so real that the Flysch was in due course entirely incorporated in the Alpine chain, and even the Molasse, though formed later and farther north than the Flysch, now lies marginally overturned and over-ridden. J. E. M. H.

266. The Northern Cordilleran Geosyncline and its Relation to Petroleum Accumulation. Cassius A. Fisher and E. Russell Lloyd. Bull. of Amer. Assoc. of Petr. Geol., Jan., 1927.

Attention is directed to the petroleum possibilities of the great province that lies between Hudson Bay and the Canadian Rockies.

A general review of the sedimentation and earth's movements within this geosyncline of 300,000 square miles, from Cambrian time to the present, indicates that the major features compare favourably with other geosynclines which have yielded large amounts of petroleum. Geologists have already outlined, in a general way, some of the probable petroleum areas, and development has centred about ten localities. The results so far obtained, together with the general favourable conditions and numerous oil-seepages, constitute evidence which cannot be ignored by oil companies desiring new producing territory. A thorough systematic exploration of the region is merited. J. E. M. H.

267. Microscopic Correlation of Oil-Bearing Formations and its Practical Value. P. P. Goudkoff. *Oil Age*, **24**, 2, 15.

The article deals broadly with the microscopic study of foraminifera in oil-bearing formations as a means of sub-surface correlation. At the commencement, it is pointed out that only rarely does the configuration of the surface of an area give a true indication of geological structure at depth. Thus, the best way to obtain an idea of sub-surface conditions is by the correlation of wells. This correlation may be effected by comparing the depths at which a certain zone is encountered in different wells, and thus it can be found out whether the intervening beds are flat, or bent to form anticlines, synclines, or monoclines. Well logs, which often depend on the drillers' observation of lithological facies, are rarely reliable, but better results are occasionally obtained with formations containing beds abounding in some easily recognised fossil. However, these relatively large fossils cannot always be used for correlation, because they are invariably destroyed by the drilling tools and appear in the well samples as unidentifiable fragments.

Within recent years, two methods of correlation have been advanced, (1) micro-lithological and (2) micro-palæontological. The former method is based on a microscopic study of the minerals in core samples, and is, in a sense, a refinement of the well-log method.

The microscopic correlation of minerals in sedimentary rocks requires some knowledge of the origin of such sediments before an accurate interpretation of results is possible. Formations frequently represent littoral or shallow water rocks composed chiefly of particles derived from the decomposition of other rocks which formed the coasts of basins of deposition. The character of the products of decomposition usually changes with progressive erosion, which cuts, step by step, deeper into the different zones on the coast. Variations in the character of sediments may be caused by other factors, such as the uplifting or subsidence of a basin, or variations in climatic conditions. A formation usually shows certain lithological changes across its thickness or from bed to bed. For successful correlation, a lateral persistence of the different zones is required, and also the same sequence in various parts of a district. Lateral persistence is more to be expected in areas which were near the coast of a former basin of deposition. The greater the distance from such areas, the shorter are the limits within which an accurate correlation by means of mineral grains can be obtained. The limitations of this method are such that one can hardly apply it to correlating different fields in the Los Angeles Basin, for example. Furthermore, the method seldom gives an idea of the geological age of the studied formation, this being another drawback to its successful application in practical problems.

The micro-palæontological method presents many advantages over the method just described, and is based chiefly upon a study of foraminifera. These very small marine animals have attracted much attention from petroleum geologists as a possible means of sub-surface correlation because (1) they are not broken by the drilling tools and (2) they occur very abundantly in marine rocks of Cretaceous and Tertiary age which furnish a very large proportion of the world's petroleum.

Foraminifera are capable of furnishing reliable correlations both between wells and formations, for the reason that they have undergone evolution in past ages. Five sub-families made their appearance in the Cambrian period, two in the Silurian, six in the Carboniferous, two in the Permian, one in the Triassic, three in the Jurassic, six in the Cretaceous, one in the Tertiary, and three in recent time. Much less time was required for creating the much more numerous genera and species. A number of genera are confined to one or two periods, and the still more restricted species and their

combinations make it possible to recognise many divisions within small intervals of time. Types of foraminifera depend very much on environment, so that succeeding changes in climate might provide increased variation in the fauna of different beds, while, on the other hand, the fauna remain essentially the same laterally over almost the entire area. The numerous species have different geological ranges, and in vertical distribution, therefore, overlap one another at short intervals. It should be understood that a reliable correlation can only be made when certain conditions are fulfilled, i.e., (*a*) there should be an abundance of foraminifera, (*b*) a knowledge of the micro-fauna characterising different parts of the formation is essential, and (*c*) samples should be secured at several horizons, so that correlations may be checked against each other. In its practical application, the method deals with the elucidation of the structural relationship of various wells, usually with regard to one another. In proved areas, a determination from core samples makes it possible to locate accurately the productive zone. In wells some distance from the proven area, the depth of the productive zone can be determined. The chances of finding a deeper zone in a given field may be gauged by correlating the productive zones with those of other fields. Finally, when drilling a wild-cat well, foraminifera often indicate at what depth the well should be abandoned. W. H. T.

268. The Location of Mineral Fields: Modern Procedure in the Investigation of Mineral Areas, and the Subsequent Verification of Their Extent. M. H. Haddock. *Nature*, 19.3.27.

The geometrical properties of mineral deposits (dip-strike, etc.) and their determination are first dealt with; two chapters follow on contouring and the form of outcrop, and mineral mapping practice. Borehole survey, ancient and modern, is described, whilst faulting and folding are treated with the aid of figures.

An important chapter on geophysics describes the chief physical methods employed, an admirable summary.

There are also chapters on spherical trigonometry and astronomical methods in so far as they concern surveying and one upon triangulation. The last chapter deals with the correlation of surface and underground surveys.

J. E. M. H.

269. The Geology of Oil, Oilshale, and Coal. Dr. Murray Stuart. *Nature*, 19.3.27.

This book is highly speculative, but interesting; it has been severely criticised from various quarters, but we are inclined to think that it will prove useful to the geologist.

The author gives "points" for the oil geologist, in which attention is directed (*a*) to dolomitized limestones, in which foraminifera with specific bacterial aid are invoked as influential contributors to the formation of petroleum, (*b*) foraminiferal or diatomaceous shales minus bottom living fossils, (*c*) the lateral variation of coal seams through torbanite to oil-shale or into liquid petroleum, (*d*) the fossil wood origin of petroleum theory, and (*e*) the association of oil with dynamically disturbed marine coals.

J. E. M. H.

270. Folding or Shearing, Which? Bailey Willis. Bull. of Amer. Assoc. of Petr. Geol., Jan., 1927.

Compressive stress in the earth's crust may cause deformation by folding and shearing. The structures in a given region depend on the type of

deformation, which itself results from the original condition of the rocks at the time of deformation.

In the Californian coast ranges deformation has been governed by shearing, particularly along the great faults such as the San Andreas. The history of these coast ranges is the history of a large number of fault-blocks, each of which has acted differently under the stresses to which it was subjected, but which is, nevertheless, related mechanically to the forces which govern the regional movements.

Such shearing may produce faulting on a large scale and secondary stresses may again cause shearing of the fault blocks.

Shearing from deep-seated compression may also produce vertical uplift, causing tension at the surface and normal faulting. Most of the structural features of the earth's crust originate in one of these types of deformation.

California offers examples of all of them, and there seems to be some relation between oil accumulation and the type of structure. On the western side of the San Joaquin Valley there has been folding due to compression. This, and the heat involved in the deformation has possibly influenced the origin of thegreat oilfields of this region. On the east side of the valley, where the structures are due to tension following bulging by deep-seated compression, no oil has been found.

The author distinguishes the three different structural developments: (1) folding proper (the Appalachian type), (2) shearing (the California type), and (3) warping (the effectof deep-seated shearing, vertical elongation of the sheared mass, tension of the surface, and normal faulting).

J. E. M. H.

Coal and Shale.

271. Composition of Light Oils from Low-Temperature Carbonisation of Utah Coal. R. L. Brown and R. B. Cooper. *Ind. Eng. Chem.*, 1927, **19**, 26–31.

A non-caking coal from the Mesa Verda bed was carbonised at a maximum temperature of 736° C. by means of super-heated steam in a continuous vertical retort (*c.f.* Karrick, *Bull.* 30, Carnegie Inst. Tech.; Frey and Yant, *Ind. Eng. Chem.*, 1927, **19**, 21). The coal contained 7·5 per cent. ash and 48·1 per cent. volatiles (ash-free dry) and from 325 kg. were obtained 242 litres of tar and 36,108 litres of gas. The latter was scrubbed with soda lime and then cooled by means of carbon di-oxide snow and acetone and then with liquid air. From 30,642 litres of gas, 1926 c.c. of liquid hydrocarbons were recovered. This condensate was first fractionated in the apparatus of Peters and Baker (*Ind. Eng. Chem.*, 1926, **18**, 69) and the eight fractions submitted to physical, and in some cases chemical, tests.

Fraction A, 528 c.c., B.P. 20° to 31° Sp. G. 0·6496 contained 67 per cent. to 69 per cent. by weight of a mixture of amylenes, the remainder being chiefly isopentane. Fraction B, 218 c.c., B.P. 31° to 45°, Sp. G. 0·6784, consisted of amylenes (85 per cent.) and normal pentane (15 per cent.). Fraction B2, 42 c.c., B.P. 45° to 55°, Sp. G. 0·6988 contained 68 per cent. of unsaturated hydrocarbons, probably 5 and 6 carbon-atom compounds in about equal amounts. Fraction C, 496 c.c., B.P. 55° to 75° C., Sp. G. 0·7208 (20 per cent.° C.). It consisted as to about two-thirds of hexenes, the remainder being 6 carbon-atom paraffins and naphthenes. The unsaturated hydrocarbons in the above fractions were characterised by means of their dibromides.

The remaining fractions were as follows:—Fraction D, 315 c.c., B.P. 75° to 100°, Sp. G. 0·7386; Fraction E, 158 c.c., B.P. 100° to 125° C., Sp. G.

0·7736; Fraction F, 77 c.c., B.P. 125° to 150° C., Sp. G. 0·7825; Fraction G, 74 c.c., B.P. 150° to 200°, Sp. G. 0·8132. Fraction D contained heptanes cycloparaffins, heptenes and cyclic olefins, but no aromatics. In Fraction E, the saturated portion consisted of one part of paraffins and three parts of cycloparaffin, the unsaturated portion being largely cyclic olefins. Fraction F contained naphthenes and cyclic olefins in about equal proportions, whilst Fraction G consisted of cyclic and non-cyclic saturated hydrocarbons, together with unsaturated cyclic bodies. H. G. S.

272. Coal Washing and Ore Concentration. T. M. Chance. U.S.P. 1,605,172 of Nov. 2. Appl., July 26, 1924.

The separation of impurities is effected by the flotation of the lighter and sinking of the heavier in a fluid mass of greater specific gravity than the lighter and less than that of the heavier materials. The fluid mass is a mixture of liquid and heavier, insoluble, finely-divided solids, which is agitated by the introduction of liquid under pressure at the bottom, where the pressure liquid passes through the accumulation of the solid constituents, elevating them and re-arranging their particles repeatedly. The solids are thus diffused over a large area in the liquid. H. M.

273. Improvements in or Relating to the Distillation or Heat Treatment of Carbonaceous and other Materials. F. D. Marshall. E.P. 261,975, Dec. 6, 1926. Appl., June 5, 1925.

Carbonaceous or other materials are forced through a retort by means of a plurality of co-acting screws, and the retort is heated internally or externally by gases from an adjacent water gas generator. A low, medium or high-temperature distillation may be carried on while the material is continuously forced through the retort by the screws, and the process of distillation may be carried out simultaneously with the manufacture of briquettes.

Means are provided for utilising the heat produced during the blow period of the gas producer and for utilising the heat from the ash produced. R. P.

274. Improvements in or Relating to Apparatus for the Distillation or Heat Treatment of Carbonaceous and other Materials. F. D. Marshall. E.P. 261,919, Dec. 6, 1926, Appl., June 5, 1925.

The method consists of moving the carbonaceous material through a vertical casing by means of a plurality of screws of the Archimedian type, the arcs of the screws being spaced so that the threads are not in contact and the vapours can collect within and be withdrawn from the space between the screws. R. P.

275. Improvements in or Relating to the Distillation or Heat Treatment of Carbonaceous Materials, and to the Manufacture of Briquettes. F. D. Marshall. B.P. 261,927, Dec. 6, 1926. Appl., June 5, 1925.

For the manufacture of briquettes or slabs from carbonaceous material, the method consists of forcing the material by means of a plurality of screws out of a casing or retort into another casing which is divided into cells by means of plates or webs. These form the material into the desired shape. A combustion chamber surrounds the retort containing the screws and the casing which forms the briquettes. The lower end of the casing is provided with hinged flap doors, which normally close the casing in a gas-tight manner. These doors are controlled so that when the pressure exerted by the feeding

screws on the material exceeds a certain limit, they are forced open and a portion of the charge ejected. The process is continuous. R. P.

276. Combined Process for Carbonising Coal and Cracking Oil. W. E. Trent. E.P. 262,302, Dec. 9, 1926. Appl., Feb. 15, 1926.

A plant is described for the economical utilisation of heat in a process for the production of liquid motor fuel and carbonised solid fuel.

A steam boiler supplies steam to drive a compressor and the exhaust steam from the compressor gas to heat an "agglomerator," wherein coal dust and heavy oil are mixed in the proportion of 5 parts coal and 1 part oil. The plastic mixture is moulded and transferred to a baking oven, which is heated by the flue gases of the steam boiler. The vapours produced in the oven from the coal and oil are conveyed to the compressor, where the heat of compression raises them to cracking temperature. From the compressor the vapours travel to a heat exchanger through which the raw oil passes before entering the "agglomerator." Any light vapours contained in the raw oil are evaporated and mix with the vapours from the oven before compression takes place. The vapours condensed in the preheater pass out to storage and carbonised briquettes are discharged from the oven. R. P.

277. Process for Obtaining Fuels from Coal and Oil Mixtures. W. E. Trent. E.P. 261,594, Nov. 25, 1926. Appl., Feb. 15, 1926.

Coal is pulverised to the fineness of 200 mesh per inch and mixed with hydrocarbon oil, 15 to 30 per cent. by weight. These are agitated together to form a plastic mass, which is injected, by means of gas, steam, or oil, into a heated coil situated within a combustion chamber.

The mixture travels towards the source of heat and the heating coil divides into a vapour outlet and a residue outlet, as it leaves the combustion chamber.

The vapours pass to a condenser and the residue falls into a receiver. The oil contained in the coal is recovered with the hydrocarbon oil from the vapours and a portion may be returned to treat a fresh supply of coal dust.

The residue of carbonised particles may be used as fuel without treatment or in the form of briquettes. The temperature of distillation is preferably about 315° C. R. P.

See also Abstracts Nos. 163, 192 and 200.

Abstracts.

Arranged by W. H. Thomas, A.R.S.M.

Abstractors—S. W. Cooke, B.Sc., W. N. Hoyte, B.A., R. P. Linstead, Ph.D., A.R.C.S., J. E. Marshall-Hall, A.R.S.M., H. Moore, M.Sc., A.I.C., F.C.S., R. Pitkethly, K. B. Ross, B.A., B.Sc., G. Sell, H. G. Shatwell, Ph.D., E. R. B. Skipwith, B.A., A. R. Stark, B.Sc., A.I.C., W. H. Thomas, A.R.S.M.

General.

278. Developments in Venezuela Reviewed by British Geologist. F. J. Leggitt. *Oil & Gas Journal*. April 7, 1927.

The article opens with a historical review. The fields are then treated separately, the history and present position of each field being traced. The varying depths to which drilling has to be taken before production is reached is well brought out, showing the complicated nature of the area. For instance, a coaly shale 1 or 2 feet in thickness has been accepted as a marker in the La Rosa Field. This is found at depths ranging from 900 to 2,000 ft. whilst the top of the first tar sand may be found at anything from 20 to 240 ft. below this. The 3 new Lagunillas fields, discovered last year, show promise. The first well came in at 3,500 ft. and produced 4,000 barrels daily. Explorations and test wells in the S.W. corner of the Lake, at El Cubo, are now being carefully watched. S. W. C.

279. A Compilation of the Data in favour of the Organic Origin of Petroleum. R. Potonié. *Petroleum*, 1927, **23**, 395–399.

The author reviews the different data and opinions of authorities on the origin of petroleum, methods of production of artificial petroleum, and the evidence to be drawn from the various fossil remains found contiguous to oil deposits. H. M.

280. Economic Aspect of Desulphurisation in Refining Cracked Motor Fuels. J. C. Morrell and G. Egloff. *Refiner*, March 6, 1927, 78.

Crude oils and residues have largely taken the place of distillates as cracking stocks and this has led to a considerable increase in the amount of sulphuric acid required for the desulphurisation of the spirit obtained. The sulphur compounds from the cracking of crude oils and residues are generally present in greater amounts and are less reactive to the usual refining materials than those from gas oils. The authors estimate that the average cracked motor spirit from heavy Californian oil requires 30 lbs. of sulphuric acid per barrel to reduce its sulphur content to the specification value of 0.1 per cent. To the cost of the additional acid must be added the increased refining loss in the spirit due to solution and polymerisation and the reduction in anti-knock value. The authors suggest that in view of these facts the sulphur specification should be increased to 0·3 per cent. and describe experiments illustrating the lowering of refining losses. It is estimated that the acceptance

of this new figure would effect an annual saving of 5 million dollars in California alone.

The objection to the higher per cent. of sulphur lies in the risk of corrosion of motor parts. It is pointed out that this can be prevented by the use of ventilating systems attached to the crankcase which prevent the condensation of water capable of dissolving oxides of sulphur and setting up corrosion.

R. P. L.

281. Developments in Refining Mexican Light Crudes. J. W. Poole. *Refiner*, March 6, 1927, 90.

A detailed description of the production of gasoline, burning oils, lubricating oils, wax and asphalt from Mexican crude oils is given. The oil referred to is that obtained from the "South Fields" area which gives distillates closely resembling Mid-Continent products. Typical yields are: Gasoline, 14·5 per cent.; kerosene, 6 per cent.; gas oil, 30 per cent.; paraffin wax, 1 per cent.; lubricating oils, 5 per cent.; asphalt, 40 per cent. The properties of the products are described.

R. P. L.

See also Abstracts Nos. 295, 305, 325, 327, 348, 393, 396 and 398.

Chemistry of Petroleum.

282. "Saturation" of the Petroleum Lubricant Hydrocarbons as Shown by Their Reaction with Bromine. Charles F. Mabery; *J.A.C.S.*, 1927, **49**, 1116.

The author's researches on the subject have now been discontinued and the results so far obtained have been collected in this paper. The method previously used (Mabery, *J.A.C.S.*, 1926, **48**, 2663), has been extended to the study of individual hydrocarbon fractions of lubricating oils from various sources. It has been shown that the reaction with bromine under the author's conditions is accompanied by an evolution of one molecular proportion of hydrogen bromide for each molecule of hydrocarbon used. The properties of the products are tabulated.

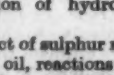
The view of Thorpe (*Science*, 1926, **64**, 236) that polymerisation and depolymerisation may account for the lubricating properties of these oils is criticised.

R. P. L.

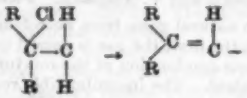
283. Action of Sulphur Monochloride on Petroleum Hydrocarbons. Lorand. *J.I.E.C.*, June, 1927.

In various petroleum fractions and crudes, sulphur monochloride is found to react, the reaction being most vigorous in the heavier fractions and crudes. With lubricating oils the reaction is violent even in the cold, but spirits only darken in colour and give a dark sediment. The reaction is characterized by the evolution of hydrochloric acid and separation of sulphur.

In order to ascertain the effect of sulphur monochloride on the various types of hydrocarbons present in the oil, reactions were carried out using individual hydrocarbons. It was thus shown that there is an outstanding difference between saturated and unsaturated hydrocarbons, that of straight chain paraffins being direct chlorination of the type—



Side chain paraffins give the same reaction on heating, but the reaction rate is higher. By continued heating to a higher temperature, probably two neighbouring carbon atoms lose a molecule of HCl and form a double bond



This product undergoes condensation and polymerisation like other unsaturated hydrocarbons.

This reaction gives rise to two methods for estimation of degree of unsaturation, the first taking account of the hydrochloric acid evolved and stopping the reaction after the first vigorous reaction and a subsequent period of heating. The second makes use of the fact that the polymers formed on heating boil in a much higher range than the parent substances and a separation by distillation is thus effected. A. R. S.

284. The Effect of Higher Aliphatic Acids on the Surface Tension of a Heavy Hydrocarbon Oil. E. C. Gilbert. *J. Phys. Chem.*, 1927, **31**, 543.

The influence of perlorganic and myristic acids on the surface tension of a pure heavy hydrocarbon oil has been measured at various concentrations by the method of Harkins, Young and Cheng (*Science*, 1926, (2), **64**, 333). The lowering of the surface tension is small in both cases, but a flattening of the concentration-viscosity curve can be observed at concentrations corresponding to 0·06 g. mols/litre of perlorganic acid and to 0·02 g. mols/litre of myristic acid. This is attributed by the author to the complete formation of a unimolecular surface layer of acid.

The adsorption of the acids on the oil surface has been calculated from the Gibb's equation, also the apparent thickness of the surface layer and its area per molecule. The figures calculated for the thickness of the unimolecular films are lower than the accepted values. These variations are attributed to association effects due to the similarity between the surface tensions of solute and solvent. R. P. L.

285. Method for Simultaneously Synthesizing Methanol and Liquid Hydrocarbons. G. Patart. E.P. 247,932 of April 28, 1927; (compare E.P. 247,178).

An extension of previous work. A mixture of coal gas and water gas in approximately equal amounts is used, a typical sample having CO_2, 3 per cent.; CO, 26 per cent.; C_2H_4, 1·4 per cent.; CH_4, 8·9 per cent.; H_2, 54 per cent.; O_2, 0·6 per cent.; N_2, 6 per cent. This is circulated for eight hours at 150—250 atm. over a zinc oxide-chromium oxide catalyst at 300° C, fresh gas being introduced as required. The liquid product is a mixture of 2·5 per cent. hydrocarbons and hydrated methanol. The spent gas contains: CO_2, 1·2 per cent.; CO, 27·2 per cent.; C_2H_4, 2·2 per cent.; CH_4, 27·3 per cent.; H_2, 16·7 per cent.; N_2, 25·4 per cent.; O_2, nil.

It is claimed that the hydrocarbons are formed from the ethylene, while the methanol is produced by the hydrogenation of the acids of carbon in the gas and subsequently from the same substances formed by the incomplete combustion of the methane. At higher pressures the reaction can be taken to a final hydrogen concentration of 4–5 per cent. R. P. L.

See also Abstracts Nos. 288, 289, 292 and 312.

Natural Gas.

286. The Helium Occurring in the Effluent Gases from Petroleum Wells. I. D. Butescu and V. Atanasin. *Petroleum*, April 1, 1927.

The helium present in natural gases from petroleum wells was estimated by either of two ways. In the first, the gas is passed over red-hot copper oxide, thus causing the complete combustion of the mixture, and then the products of combustion are absorbed. The incombustible residue is then passed over heated magnesium and calcium to remove the nitrogen. The remaining gases are separated from the helium by cooling in liquid air and passing through absorbtion charcoal.

In the second method the hydrocarbons and carbon dioxide are removed by condensation by liquid air, and then the residual gases are passed over absorbtion charcoal at the temperature of liquid air. The only gases thus remaining with the helium do not affect the spectrum analysis. The known volume of gas is introduced into the analysis apparatus, which is subsequently evacuated to known absolute pressure. Part of this apparatus is a vacuum discharge tube and a spectroscope is focussed on this. A table of data obtained is given.

A. R. S.

287. Elimination of Wild Fractions by Recycling in Manufacture. A. B. Morris. *The Refiner*, April, 1927.

Two recent designs of plant for this purpose are described. In the first the fat oil is discharged from the main absorber into a vent tank so arranged as to present a large exposed oil surface and the pressure is dropped to about 5 pounds. The vapours thus vented are conducted directly to the secondary absorber, through which a small part of the cold lean oil is circulated, the enriched oil from this absorber discharging into the same vent tank. The fat oil is then conveyed by means of pumps through the heat exchanger, preheater and evaporator to the lean oil tank, where it is picked up by the lean oil pumps and recycled. Due to the greater solubility in oil of the heavier fractions of the vapours passing off the vent tank, these are practically all recovered in the secondary absorber.

In the second plant the fat oil passes through the heat exchanger before discharging into the vent tank, where the pressure is reduced to about 20 pounds. The vapours released from the hot fat oil are passed directly to a vapour condenser, and the condensate is accumulated as high gravity, low recovery Grade C make. The hot fat oil is cooled in the vent tank and then pumped through the preheater, where it is raised to about 400° F., and on to the evaporator, which it leaves at 325° F., and is recycled by the lean oil pumps. The pressure in the evaporator is maintained at 20 pounds, and the vapours produced there are condensed and accumulated as low gravity, high recovery Grade A make. Due to the removal of the wild fractions before the final heating, less still and dephlegmator capacity are required and there is less temperature drop in the evaporator, tending to give a more complete purging of the oil and producing greater efficiency in the absorbers.

S. W. C.

288. Manufacture of Amyl Acetate from Natural Gasoline. G. T. Koch and G. A. Burrell. *Ind. and Eng. Chem.*, 1927, **19**, 442.

The starting material was a pentane fraction from natural gas gasoline of boiling point 25—40° C. This was chlorinated in a lead-free glass tube in ultra-violet light, using a carrier such as activated carbon or silica gel. The chlorine was introduced at the bottom of the tube from a vertical jet. 78 per cent of chlorpentane containing some 19 per cent of amyl chloride was

obtained. The amyl chloride of boiling point 90—110° C. was converted into the acetate by the action of sodium acetate. This operation was carried out in an autoclave in the presence of charcoal, using a temperature of 200—450° F., and a pressure of 200—250 lb. The product after fractionation compared favourably with technical samples.

In connection with this work a method was devised for the estimation of chlorpentanes in amyl acetate, based on their relative insolubility in concentrated sulphuric acid. Satisfactory results were obtained.

A cost sheet for the process is given. R. P. L.

289. Amyl Acetate from Natural Gasoline. G. T. Koch and G. A. Burrell. *Oil and Gas Journal*, April 7, 1927.

Natural gasoline is first fractionated in a copper-lined, steam-jacketed rectifying still, the fraction boiling between 25° C. and 40° C., which is mainly pentane, being collected. This is then chlorinated in a special apparatus, where the chlorine is bubbled up through the pentane, carrying with it activated charcoal which acts as a catalyst. In order to produce as little as possible of the di- and tri-chloride derivatives, the reaction is stopped when about 20–25 per cent of the pentane has been chlorinated. The product is then run off into agitators, where it is neutralised with 10–20 per cent caustic soda. After water washing it is fractionated, the pentane being returned for retreatment. The amyl chloride comes over between 90° and 110°. C This, after washing and drying, is charged to an agitator equipped autoclave together with fused and ground sodium acetate. Carbon is used as a catalyst. The autoclave is raised to 450° F. under a pressure of 200–250 lb., a fall in pressure indicating the completion of the reaction. The esterified product is distilled directly from the autoclave. After washing, the liquid is fractionated, the amyl acetate coming over at 120° C. to 175° C., this being a technical grade product, which can be purified by redistillation and washing. S. W. C.

290. Process for Obtaining Light Oils by Washing Gases. I. G. Farbenindustrie Aktiengesellschaft. E.P. 254,287. March 17, 1927.

The patent describes a process for washing coal gas or natural gas in order to obtain benzol or light spirit. Tar oil or petroleum oil is normally used for washing these gases, but according to the invention, a far more efficient washing oil is the extract obtained when treating petroleum with liquid sulphur dioxide. It is claimed that whereas ordinary washing oil only extracts 3 per cent. of its weight of benzole, the sulphur dioxide extract, under the same conditions, will absorb as much as 6 per cent. W. H. T.

291. Apparatus for Absorption and Distillation of Hydrocarbons. D. T. Newton. U.S.P. 1,628,055.

Casing head gas is dissolved in a suitable medium such as kerosene and then distilled so as to give the maximum yield of stable motor fuel.

The apparatus consists of a shell divided into seven chambers. The topmost chamber, known as the distilling chamber, has a pair of spray atomisers fitted to an inlet pipe, a vapour take-off line and a liquid take-off line fitted with a float valve which will not allow vapour to pass. The bottom chamber is the vapour supply chamber and has a vapour inlet pipe.

The intermediate chambers are the "blending chambers." The bottom of these chambers has a number of slots over which small open tubes are fixed, the tubes being surrounded by baffles. An overflow tube is fitted to each chamber, connecting with the one below. The liquid on the floor of each chamber is heated by means of a steam coil.

The preheated medium is forced under pressure through the atomisers in the distillation chambers, the vapour formed being led down to the supply vessel, where it is mixed with live steam. The absorption medium flows from the distilling chamber into the topmost blending chamber. The vapours pass through the series of blending chambers, being scrubbed each time until finally they are led off and condensed. The medium flows down and is drawn off, having lost all its dissolved vapour.

The success of this method depends on controlling the velocity of the vapours through each blending chamber. This is accomplished by fitting a double-bottom fitted with slots coinciding with those in the bottom of the chamber. This double-bottom is so constructed that it may be slid backwards and forwards by means of locknuts outside the shell, thus making the two sets of slots coincide fully or not. K. B. R.

See also Abstracts Nos. 292, 399 and 407.

Motor Spirit.

292. Amyl Alcohols from Gasoline. S. D. Kirkpatrick. *Chem. and Met. Eng.*, 1927, **34**, 276.

The industrial production of amyl alcohols from casing-head gasoline according to the method now used by the Sharples Corporation is described and a survey of the economic factors affecting production is given.

A grade of casing-head gasoline containing 20—40 per cent. of pentanes is used as raw material and from this a fraction of b.p. 28—37° C. is removed by fractionation through a Badeger column. Chlorine gas is added to this fraction after vaporisation and the mixture passed under pressure into a tubular reaction unit. The hydrogen chloride evolved is recovered separately in silica vessels. The amyl chloride, after fractionation, is hydrolysed with 10 per cent. caustic soda in the presence of a catalyst. The alcohol fraction obtained is a mixture of some 50 per cent. *iso*-amyl alcohols, 25 per cent. *n*-amyl alcohol and 25 per cent. diethyl carbinol. The final product may be converted into acetate by acetylation with acetic and sulphuric acids in copper apparatus. R. P. L.

293. Contact Treatment of Gasoline with Clay. O. J. Clark and A. M. Gundelfinger. *The Refiner*, April, 1927.

The authors point out that the clay should be dried before use, though not completely, as it is found that although the efficiency increases inversely with the moisture content up to a certain point, it decreases past that point. Again, the gasoline must be dry, as water, when present in sufficient quantities, agglomerates the mud. The authors consider that the action of the clay is confined mostly to the absorption of colloidal particles.

The gasoline is first treated with sulphuric acid, then caustic soda and then after thorough mixture with clay, is put through a filter press. This gives a product free from sediment, 30+ Saybolt in colour, negative to doctor test, negative to corrosion test, and neutral. Clay alone in sufficient amounts will produce a colourless product but will not remove sulphur compounds, and therefore a combination of clay and acid treatment is found more satisfactory.

A description of the actual plant installed by the Marine Refining Corporation to deal with this treatment is then given. S. W. C.

294. TREATMENT OF CRACKED NAPHTHA WITH SULPHURIC ACID AT LOW TEMPERATURES. E. N. Klemgard. *The Refiner*, May, 1927.

The author points out that it is not sufficient to take into account only the volume loss during the refining of a cracked naphtha, but consideration must be given to the increase in the boiling-points of the various hydrocarbon constituents. This latter is best determined by an estimation of the per cent. of test gasoline in the naphtha before and after treatment, this being made by the 4-point control method, an outline of which is given.

A typical crude pressure naphtha having the following properties was then treated :—

Gravity °Be	44.6
Per cent. sulphur	·55
Per cent. "Acid Oils" (phenols, cresols, etc.)	·35
Per cent. "Navy" test gasoline	51·00

This was first treated in a commercial plant operating continuously in the following manner. The naphtha was thoroughly mixed with caustic soda to remove H_2S, the greater portion of the acid oils, and other impurities. The mixture is passed to settlers, where the soda is withdrawn. The naphtha is next treated with salt water sprayed in counter-current direction, this also being settled off, before the naphtha is treated with sulphuric acid at ½ lb. acid per gallon of naphtha. The sludge is then settled and the remainder washed out with salt water, when the naphtha is further treated with 4 per cent. of caustic soda which, after settling and separating, gives the finished product. Even after accounting for the oil from the acid sludge as much as 10 per cent. of the naphtha treated is lost, though with careful control the treating yield should be 96 per cent. The properties of the finished product are :—

Gravity °Be	43·0
Per cent. sulphur	·45
Per cent. "Acid Oils"	Trace.
Per cent. "Navy" test gasoline	43.5

The difference between the per cent. test gasoline in crude and treated naphtha is 7·5 per cent, but this represents a loss of 14·7 per cent. of the total gasoline in the crude naphtha. Assuming a treating yield of 96 per cent. there will be an additional 2 per cent. loss, making a total of 16·7 per cent. Navy test gasoline lost during refining. This cracked naphtha is then distilled with steam to recover the gasoline, a list of the quality tests for which are given, the most interesting being a poor gum test of 17 per cent. unsaturateds. The temperature of the naphtha when in contact with the acid was about 140° F. but in laboratory treatments where the temperature was below 80° F. and above 40° F. the polymerisation losses were the same.

In the second case the crude naphtha had to be passed through a layer of acid sludge to free it from water, which otherwise solidifies and clogs the lines. The naphtha is cooled in heat exchangers by means of ammonia, till it reaches 15° F., and then passes to a centrifugal pump where sulphuric acid, either 66° Be or 150° fuming is mixed with it. Two-tenths of a pound of acid per gall. of naphtha are used. The mixture must again be cooled to maintain the temperature at 15° F., and then passed to an insulated settler, where most of the acid separates. The naphtha is again refrigerated and given the same treatment and passed to a second settler. From here the

naphtha is finished as in treating cracked naphtha under ordinary conditions. The naphtha treated in this way has the following properties :—

Gravity °Be	44·1
Per cent. sulphur	·30
Per cent. Navy test gasoline	49·0

The difference between the per cent. Navy test gasoline in the crude and cold-treated naphtha is only 2 per cent. which represents 3·9 per cent. of the total gasoline in the crude naphtha. A treating yield of 98 per cent. can be obtained. A list of the quality tests of the gasoline obtained by steam distilling the treated naphtha follows and it will be noted that these are all better than those for the gasoline produced under normal conditions, and in particular that it gives a fair gum test and has 20 per cent. unsaturateds.

S. W. C.

295. The Motor Fuel of To-morrow. T. A. Boyd. (Paper read before seventh annual meeting A.P.I.)

One half the horse-power available in the U.S.A. is in automobile engines; were these to run at full power continuously for a year three hundred billion gallons of gasoline would be consumed; actually ten billion gallons is consumed, representing fifteen times the total power of Niagara. Two aspects are discussed—the available supply and the characteristics of the requisite gasoline. The estimate of the Committee of Eleven is quoted—that 4 per cent. of the reserves of liquid fuel and potential liquid fuel is gasoline, potential oil from shale is 14·7 per cent., from coal is 71·5 per cent., from lignite 9·6 per cent. With regard to gasoline conservation, research should include (1) increasing petroleum production by the use of more scientific methods and by improving the recovery from sands through flooding and using compressed air or gas, (2) by improving refinery practice to give a higher recovery of motor fuel, (3) by improving cracking processes, (4) by modifying the constitution of gasoline to enable it to be used in more efficient engines. Subsidiary lines of research are (1) the fermentation of vegetable products, (2) the distillation of oil shale, (3) the carbonisation of coal and lignite, (4) the direct hydrogenation of coal, (5) the synthesis of alcohols and hydrocarbons from gases produced from coal. The time factor required for the development of a commercial process is stressed. The efficiency of vegetation as a fuel producer is quoted as $\frac{1}{2}$ per cent. The crops eaten by horses in the U.S.A. have an alcohol equivalent of twelve billion gallons.

The desirable characteristics of the motor fuel are (1) high heating value, (2) suitable volatility, (3) freedom from tendency to knock. The need of a definite standard of volatility is stressed. With regard to knocking, the standards required are—a minimum tendency to knock for any fuel on the market, a standard method of measuring this tendency and a standard fuel of reference. Graham Edgar's standard fuels of reference are mentioned—normal heptane and tri-methylisobutyl methane.

W. N. H.

296. Fuel Characteristics and Engine Starting. J. O. Eisinger and T. S. Sligh, junr. (Paper read before 7th annual meeting A.P.I.)

The work is a progress report in connection with co-operative research on the part of the A.P.I., the National Automobile Chamber of Commerce and the Society of Automotive Engineers. Completion of work is reported in connection with fuel volatility and engine characteristics influencing engine starting. Further research is being undertaken regarding the warming-up period.

Two engines were used for the tests, a four-cylinder truck engine and a six-cylinder car engine. A single jet was used instead of a conventional carburettor, the engine was rotated at 100 to 150 r.p.m., the time interval was observed between the turning on of the fuel supply and the first audible explosion. Rates of fuel feed were plotted against starting time; approximately hyperbolic curves were obtained.

In order to examine relative volatility of fuels at low temperatures, fuel-air mixtures were supplied to an evaporating coil maintained at constant temperature, the unevaporated portion of the fuel was collected and measured. A method of examination of the ignitability of fuel-air mixtures consisted in introducing a known amount of fuel into a glass spherical bomb; equilibrium is established by a stirrer, and the ignitability of the mixture is tested by the passage of a centrally situated spark. At various temperatures the data obtained with this apparatus are in good accordance with engine tests.

The general starting characteristics of the two engines used were found to be very similar. The effect of cranking speeds was examined. At 150 and 200 r.p.m. the total amount of fuel required for starting is the same; below 130 r.p.m. more is needed, other conditions being steady. Plotting total number of revolutions required for starting against rate of fuel feed, it was found that the number was constant for a given mixture ratio.

To investigate vaporisation in the induction pipe a special pipe was used with three times as much wall surface for a given cross-sectional area as for a conventional induction pipe. No appreciable improvement could be detected in starting of the engine; this is thought to be due to the greater quantity of fuel required to wet the surface of the pipe. An examination of the effect of change in compression ratio shows that the effect on starting is largely the result of difference in dilution of the incoming charge by air retained in the clearance volume. The use of an atomising jet (such as a scent spray) leads to much less fuel being required for starting compared to when a conventional jet is used; this was found to be due to more uniform distribution of the fuel in the mixture. Warm fuel was found to start more easily than cold.

The outline is sketched of the technique of acceleration tests on the six-cylinder engine during the warming-up period. An exact description of the apparatus used for air distillation tests is given, in which fuel-air mixtures traverse a constant temperature coil. The manner of use and the probable extent of the errors involved are stated.

In the discussion following the paper Dr. Dickinson considers that the A.S.T.M. distillation curve, if run with proper precaution, will give a pretty good criterion of the starting properties of a fuel. He outlines the probable sequence of events occurring in the engine during starting up. W. N. H.

297. Adding Explosives to Automotive Fuels. *Petroleum Times*, April 16, 1927.

The idea, which has several times been patented, of adding explosives to automotive fuels in order to add to the energy of the fuel released in the cylinder, is shown to be based on a falsity. The heats of combustion of many explosives are given, together with that of the usual automobile hydrocarbons. The explosives are shown to have an average of about one-tenth the energy per gram compared to internal-combustion fuels. The only property which makes explosives useful in their own spheres is the suddenness with which this energy is liberated. The use of explosive ducts is discounted until an acute liquid fuel famine occurs. W. N. H.

298. Refining Oils. H. O. Parker. U.S.P. 1,622,870 of Mar. 29, 1927.

A continuous process for the refining of oils by means of hypochlorite solution is described. The method is particularly valuable for light petroleum oils, such as casing-head gasoline, which are only available in small quantities and which deteriorate on keeping. The oil is passed through a column of aqueous hypochlorite solution containing an excess of alkali. Fresh alkali is added at one end of the column and chlorine is introduced at the other end nearest the point at which the oil enters. In this way the oil is subjected to an initial high concentration of hypochlorite. A suitable form of apparatus is described. R. P. L.

299. Method of Treating Petroleum. R. Cross. U.S.P. 1,623,018 of Mar. 29, 1927.

Petroleum oils or distillates are divided into major and minor portions, the latter amounting to 1 per cent. in a typical experiment. The minor portion is treated with molecular chlorine in an absorption tower, preferably in the presence of ultra-violet light. Solution is effected to about 1 lb of chlorine per gallon. The treated portion is then added to the bulk of the oil in an agitator. It is claimed that the alkyl chlorides produced in the first stage react with the sulphur compounds in the bulk of the oil with the formation of sulphonium chlorides. These may be removed by washing with water. The treatment may be followed by refining with plumbite solution, clay, etc. R. P. L.

300. Improvements relating to the Removal of Benzol from Gases containing the same. E.P. 257,900. I. G. Farbenindustrie Aktiengesellschaft.

Benzol and its homologues are usually removed from vapours containing them, such as coke oven vapours, by washing the vapours with tars or mineral oils. It is found that the products obtained by hydrogenation at elevated temperature and pressure in the presence of a catalyst of these tars and oils, are very much better absorbents for aromatics; less washing material is required, and owing to the slower formation of resinous bodies these materials may be used for a longer period. K. B. R.

301. Process of Manufacturing Gasoline. H. Thomas, Assr. to Sun Oil Co., Philadelphia. U.S.P. 1,624,692. April 12, 1927.

Gas oil is cracked under pressure and allowed to expand to the vapour state. This stream is subjected to fractional condensation by bubbling through a condensate of the same stream, and then the vapours pass downwards through a bed of some decolorising material such as clay, bauxite or fuller's earth, maintaining the bed at such temperature as will permit of condensation of part of the vapour stream. The remainder of the gas stream is condensed in coils and the whole conveyed towards the locus of decolorisation. A. R. S.

See also Abstracts Nos. 280, 287, 290, 291, 302, 337, 341, 347, and also those under the heading of Antidetonation.

Kerosine.

302. Sweetening Hydrocarbon Oils. M. G. Paulus. U.S.P., 1,628,423. May 10, 1927.

Hydrocarbon oils, particularly gasoline and kerosines may be sweetened by the addition of hydrogen sulphide in suitable amount, followed by treatment with sodium plumbite solution. The hydrogen sulphide can be used either as such or in the form of still gases. 0·001 per cent. solutions of

the gas were found to effect the desired refining in certain Wyoming oils.
R. P. L.

Fuel Oil.

303. BURNING HEAVY RESIDUAL FUELS AT REFINERIES. W. E. Perdew. *The Refiner and National Gasoline Manufacturer*. Feb., 1927, 72.

This is an account of experiences and of plant used in burning heavy Dubbs still residues at a refinery of the Derby Oil Company at Wichita, Kansas. The methods described may possibly be equally applicable to the burning of other heavy residues.

The Dubbs plant under consideration is used to produce 75 per cent. pressure distillate from topped crude, thus leaving a residuum quite unsuitable for a commercial fuel, while any increase in yield would involve a risk of the residuum draw off lines plugging up.

The residuum from the Dubbs stills is blown directly, without previous cooling, into a residuum flash still, of which two are available, one acting as a stand-by. The stills are well lagged, butt welded, steel cylinders 10 ft. 8 ins. in diameter by 16 ft. 5 ins. high with a domed roof 1 ft. 11 ins. high and a conical bottom 3 ft. 2 ins. deep. They are mounted vertically with the bottom about 6 ft. above the ground and are provided with manholes, a 24 in. manhole in the top and another 18 ins. diameter at the bottom of the cone. The residuum line from the Dubbs chambers is 2 inches diameter, extra heavy, and is thoroughly lagged.

Steam is admitted near the bottom of the still through a circular perforated pipe and a distillate taken off overhead through a 6 in. vapour line to a condenser containing about 900 sq. ft. of Sterling sections. The average working temperature of the stills is about 500° F., but this may vary from 350° F. to 600° F. The average product from the stills is a gas oil showing an initial boiling point of 250° F. and a final boiling point of 738° F. The yield is dependent on many variables but may be taken as from 5 per cent. to 7 per cent. of the charging stock.

The residue in the flash still is circulated continuously, by one of a pair of pumps drawing from about 2 in. above the cone bottom, through a lagged pipe 1½ in. in diameter surrounding the Dubbs stills and thence back to the flash stills by way of a valve for maintaining pressure in the line. Duplicate suction lines to the pumps are provided, as considerable trouble has been experienced through these clogging up, and they are made in such a way as to facilitate cleaning, as also is the air chamber which it has been found necessary to place on the discharge side between the line and the Fisher pressure governor employed. The amount of oil circulated is estimated at 4 or 5 times that burned in the furnaces.

Connections from the circulating line to the oil burners are of ¼ in. pipe with a shut-off valve and steam connexion placed as close as possible to the line so that the burner and connecting pipe may be steamed out immediately the burner is shut off. It has been found that any residuum allowed to remain in a pipe long enough to cool appreciably leaves a hard deposit, insoluble in any hot residuum which may subsequently be circulated, which can only be removed mechanically.

Two burners are fitted to each furnace and if one clogs up the other is lighted while the first is cleaned.

The amount of residuum available in the flash stills is controlled partly by the amount of steam blown through and partly by the manner in which the Dubbs stills are being worked. It should be so arranged that just before a Dubbs still is cut out the flash still is ready to receive all the residuum, some of which must otherwise be blown to waste.

Flash stills require cleaning out every 8 to 10 days. The procedure of the change over is first to warm up the empty still for a few hours with steam and then to charge the still by blowing into it the residuum from the next Dubbs unit to be cut out. The circulating pump continues to draw oil from the first still until it is empty, while the oil returning from the circulating line is diverted into the still being started. When the first still is empty the suction of the pump is transferred to the second still.

After being cut out steam is blown through the bottom of the cone of a flash still for from 12 to 18 hours to remove all gas oil possible; the vapour line is then cut out and steam blown through the regular opening. Any liquid remaining after this operation is blown out into a small pond lined with coke and disposed of for surfacing roads. Cold water is now turned into the still, which after a day or two is cool enough for a man to enter with a bar to clean out. The material remaining is brittle and easily removed, about 10 to 15 tons being extracted at each clean out, equivalent to about 1 ton per 1,000 barrels of charging stock. This material pulverises easily and is disposed of to a neighbouring cement plant.

The total cost of the plant was about $14,000, of which the stills cost $1,300 each and the pumps $765 each, the remainder representing piping, fittings, foundations and labour.

The plant has been in use for about 18 months on full time and upkeep has been very low. One man is required 24 hours per day to control the plant and also to repair, clean and service all burners. Cleanouts cost about $10.00 per time.

This hot residual oil has given a better fire with more uniform furnace temperatures than a mixture of Dubbs gas and natural gas. The operation of the equipment depends on the following properties of this class of residues:—

1. At high temperatures (350° and above) there are no solid particles to speak of in the residues. What solid particles there are are apparently partly in suspension and partly in a colloidal state.
2. The gas oil that is flashed off acts as a precipitant for these tarry particles and the residue is more homogeneous and more thoroughly fluid without the gas oil than with it. E. R. B. S.

See also Abstract No. 343.

Lubricating Oil and Wax.

304. Methods of Investigating Transformer, Switch and Turbine Oils. G. Baum. *Z. angew Chem.*, 1925, **39**, 473-5.

Comparison is proposed between the A.E.G. oxidation test (using sodium peroxide), the Schwary-Marcusson test (50 hours at 120° C), and the Umpire method (70 hours at 120° C. + 2 bubbles of oxygen per second). It is pointed out by the author that oils which form less "tar" than the specified amount allowed, frequently are unsatisfactory when in use. It has been proposed by Heyden and Typke that only the insoluble sludge formation be considered when determining the quality of an oil. It is also stated that air should be used instead of oxygen.

Oils intended for use in transformers, switches, or turbines should be low in content of unsaturated hydrocarbons. The following test is put forward as being suitable for the determination of unsaturated bodies:—

5 c.cs. of the oil are placed in a graduated centrifuge bottle of 15 c.cs. capacity together with 5 c.cs. of sulphuric acid (S.G. 1·84). The mixture is air blown for a period of half an hour, after which it is centrifuged at 3,000 revolutions per minute for 10 minutes. The increase in the volume of the

acid layer is determined after centrifuging, the maximum increase allowable being 5 per cent. W. H. T.

305. LUBRICATION. W. R. Ormandy, D.Sc., F.I.C. A paper read at the Joint Meeting of The Institution of Mechanical Engineers with the Society of Chemical Industry, on Friday, March 25, 1927, at 5.15 p.m.

The paper deals mainly with the problem of solid and liquid interfaces, and particularly with the bearing of this problem on that of lubrication. The author shows at the beginning that the surface layer of liquids is largely influenced by the shape of the molecule and the presence of it in polar groups. The work of Langmuir is next quoted, in which this worker calculated the amount of palmitic acid required to cover a given area of water surface. By measuring the surface tension of the film in comparison with the surface tension of water he was able to determine the cross section and length of the molecule. From a comparison of these results with those obtained using fatty acids and glycerines, it is suggested that in the long-chain compounds the carbon atoms are either zig-zag or spirally arranged. This is the first point which has direct relationship to the lubrication problem, for if there are forces on the surface of the metal like those on the surface of a water layer, then polar bodies might be expected to take up oriented positions on the metals. As the length of the chain increases, and there is attraction between the chains, so the space occupied by the polar head becomes less.

Harkins considers that when a bar of octyl-alcohol is broken the molecules on each side of the break orientate themselves so that the final break occurs between the ends of the hydrocarbon chains, that is, in the position which incurs the least possible expenditure of work. Very considerable forces are in action at the interfaces of liquids, and the chemical constitution of the molecules is all important in determining the eventual arrangement at the interface. Solid surfaces exhibit similar properties, and often in an even higher degree. For example, the face of a crystal of calcspar can cause an isomorphous material, such as sodium nitrate, to crystallise in such a way that the crystals grow in regular orientation to the calcspar surface. As the attraction between the atoms in the crystal is electro-magnetic, those atoms which are in the crystal face have fields of energy immediately above the face, and it would be expected that atoms placed at the edges of crystals would exert greater external action than those in the middle of a face. Again, in practice it has been found that a micro-crystalline or amorphous material will exert greater action externally than will the centre of a crystalline face. Thus, in continuation it has been proved by Hardy's work that gases and vapours can be adsorbed on to a surface, in layers many molecules thick, but the energy with which the second and further layers are held in position is very small compared with that with which the first layer is held. In addition, it has been shown by Shearer that polar bodies are orientated on solids in the same way as they are on a water surface. Saturated hydrocarbons are adsorbed on most solid surfaces, but they are easily displaced from metal surfaces by alcohols or fatty acids having strong polar groups.

It is interesting to note here that materials such as fuller's earth, charcoal, bauxite, etc., adsorb unsaturated bodies much more readily than saturated ones, and also that the heat which is generated during adsorption is in some degree a measure of the saturation of the bodies adsorbed.

Hardy has shown that if very thin layers of non-polar bodies be formed on optically true surfaces, which are afterwards brought into contact, such surfaces show a minimum coefficient of friction immediately. When polar bodies are similarly employed, there is a considerable time lag before the state of minimum friction is attained. It is suggested that in the case of

polar bodies, some time is necessary for the long rod-like molecules to sort themselves out so that the polar ends are on the metal faces. When a non-polar oil is mixed with small amounts of polar oil, there is a much shorter time lag, since it is easier in this case for the polar end molecules to attain the desired position. When a mixture of polar and non-polar lubricants is employed, so long as there is more than 0·7 per cent. of the polar body, the friction is of the order of that of the polar body alone. The latter point is of great practical value, and it is this which is referred to in the work of Southcombe on the production of commercial lubricating oils, consisting largely of non-polar products mixed with small quantities of polar bodies such as oleic acid. If two thoroughly clean plane metallic surfaces be brought into contact, siezure occurs if an attempt be made to move the faces tangentially. Two such surfaces in contact will still offer great resistance to tangential movement, even if a lubricant having a very low vapour pressure, such as oleic acid, be brought into contact with the edges of the plates. The mere presence of the vapour of a polar liquid having an appreciable vapour pressure will cause the plates to slide over each other with little effort, the time necessary for this release being a function of the volatility of the lubricating vapour employed.

No means has yet been devised for the measurement of "oiliness," but the property of adhesion is probably at the basis of the conception of oiliness, and assumes enormous importance when the lubricating film falls to an extremely low value.

The laws governing the frictional resistance in a bearing vary from those of solid friction for a very imperfectly lubricated surface, to the laws of viscous liquid flow when the lubricant is abundant. The work of Hardy deals chiefly with lubricating films of extreme tenuity, whilst other workers develop films of considerable thickness, and get steady results, by immersing the bearing in a bath of the lubricating oil. It may be doubted whether the conditions of limiting lubrication occur in practice, except very rarely. Recent experiments by A. E. Becker on the thickness of oil films between the plane surfaces of two discs, one fixed and one rotating, give results varying from 2—20 wave-lengths of sodium light. These are of an order very different from the mono-molecular layers of Langmuir and Hardy.

The viscosity of lubricating oil is clearly a very important factor, and oils with the flattest viscosity curves are always preferred. However different may be the viscosities of mineral lubricating oils at ordinary temperatures, the viscosity curves approach very closely as the temperatures become higher, until at 200° F and still more at 300° F, the differences become comparatively small. Generally speaking, oils with a low specific gravity have flatter temperature-viscosity than those of higher gravity.

High flash point of a lubricating oil, having regard to specific gravity and viscosity of the sample, is some evidence of a narrow cut in the distillation range. Volatility, taken in conjunction with the nature of the residual oil, is a very valuable test when the oil is to be subjected to high temperatures under oxidising conditions. The products of oxidation may be asphalt-like bodies which are insoluble in the oil, and so lead to stoppage of oil ducts. Moore observes that the sludge produced from lubricating oils during oxidation tests bears a close relationship to the sulphur content of the oil.

On the other hand, paraffin liquidum is known to be a poor lubricant and Dunstan and Thole have pointed out that the best lubricants are the bodies which can be removed by over treatment with sulphuric acid during refining.

Hoblin showed that if small quantities of lubricating oils be heated in porcelain dishes, to 250° C. under atmospheric conditions, the oil hitherto homogeneous when viewed under the microscope, eventually becomes heterogeneous,

and that gradually dark coloured insoluble bodies separate out. It is stated that the length of time which elapses before the formation of dark particles is a measure of the suitability of the oil for crank use. There is no doubt that finely divided metals greatly increase the tendency of oils to oxidise, and continuous filtration of crank case oils for the removal of metallic particles has been proved to lead to greatly increased life of the oil and of the bearing.

W. H. T.

306. Lubricating Oils—Laboratory Tests in Relation to Practical Results. A. G. Marshall and C. H. Barton. Paper before Chemical Engineering Group, April, 1927.

The correlation of results from laboratory tests with practical trials in engines is costly, but the authors have spent several years on investigation into the properties of lubricating oils and have checked their results by actual trials under operating conditions.

Oiliness.—Certain tests have been put forward to show that the "oiliness" of a mineral oil is improved by the addition of fatty oil, such tests being carried out on the Lanchester worm gear tester or the modified Thurston machine. The test best known to the authors is by the Deeley machine, and with this the coefficients of friction of mineral oils varied from 0·15 to 0·18. The degree of refining affects the Deeley value, the more highly refined oils having the highest value, i.e., the lowest "oiliness." Fatty oils and mixtures of mineral and fatty oils have lower values than mineral oils, typical results being :—

	Deeley Value.
600 Red	0·155
600 Red plus 1% sperm oil	0·145
600 Red plus 5% sperm oil	0·133
600 Red plus 10% sperm oil	0·115
600 Red plus 20% sperm oil	0·102
Sperm Oil	0·098

The oiliness of a mineral oil is certainly increased by the addition of fatty oil and a lot of experimental work was carried out to determine the effect on practical performance. The piston testing machine used consisted of a single cylinder engine, minus sparking plug and valves. The crank was driven by an external motor with a swinging field and the friction measured by the torque required. Piston friction was also measured by the rise in temperature in the water jacket. Results showed no difference between straight mineral oil and oil of same viscosity compounded with 10 or even 20 per cent. of fatty oil.

Similar results were obtained on actual engines under running conditions. A mineral and a compounded oil of equal viscosities (126 secs. Redwood I at 140° F.) tested on a sleeve valve single-cylinder engine (2·89 in. bore, 3·25 in. stroke, compression ratio 6:1) gave the following results :—

Speed r.p.m.	Oil A. (Compounded) B.M.E.P. lbs./in.²	Friction (B.M.E.P.)	Oil B. (Mineral) B.M.E.P. lbs./in.²	Friction (B.M.E.P.)
850 ..	98·9 ..	— ..	98·0 ..	—
1,000 ..	102·0 ..	— ..	101·5 ..	—
1,400 ..	106·8 ..	21·3 ..	106·6 ..	21·3
1,600 ..	107·1 ..	23·2 ..	108·5 ..	23·4
1,800 ..	105·8 ..	25·0 ..	106·3 ..	24·8
2,200 ..	91·3 ..	28·7 ..	91·3 ..	29·0
2,400 ..	85·5 ..	30·6 ..	84·5 ..	30·6

Under normal lubrication, differences in power and friction are negligible and within experimental error.

Attempts were made to find engine conditions which would show the effect of fatty oil addition, and this was found possible by reducing lubrication of the cylinder to practically vanishing point. A single-cylinder 5-9 h.p. stationary engine was fitted with baffles across the cylinder mouth and run under three conditions :—

(*a*) Full lubrication, no baffles, full oil pressure. Rate of oil consumption, about 1 pint in 6 hours.

(*b*) Reduced lubrication with baffles and full oil pressure. Oil consumption about halved.

(*c*) With baffles and substantially reduced oil pressure. Oil consumption negligible in 6 hours.

Friction was measured by a deceleration test. The load was removed and the engine stopped, the number of revolutions which the engine took to come to rest being the best indication of piston friction under running conditions.

A mineral oil of viscosity 235 secs. Redwood I at 140° F. and the same oil compounded with 2·5 per cent. of fatty oil, gave the following results, the engine being fitted with an aluminium piston :—

Lubrication condition.	Average deceleration (revs. to stop from 900 r.p.m.) A. Flooded.	B. Moderate.	C. Starved.	Difference A—C
Mineral oil	406	405	389	17
„ „ 2·5% lard oil	407	401	369	38
„ „ wool grease	417	412	417	0
„ „ sperm	419	411	413	6
„ „ rape	416	417	410	6
„ „ coconut	417	415	399	18
„ „ whale	419	416	371	48
Mineral oil (repeat)	410	416	400	10
„ „ 2·5% coconut	405	410	399	6
„ „ ground nut	407	408	401	6
Mineral oil (repeat)	435	425	407	28
„ „ 2·5% red fish	421	417	404	17
„ „ lard	426	420	393	33
Mineral oil (repeat)	426	422	401	25

From the above experiments it is clear that increased oiliness only shows an advantage under conditions which could not be tolerated in practice. Even then, only a limited number of fatty oils would give any benefit.

In the above experiments the water jackets were kept at 45° C., and to examine the effect of high wall temperatures, a special cylinder, with a short water jacket, was fitted to one of the stationary engines and enabled temperatures as high as 200° C. to be obtained. Friction was observed by the deceleration test and the best performance was given by straight mineral oil. Certain oils containing fatty oils failed to complete the test of 50 hrs., due chiefly to decomposition of the oil, the increased oiliness being more than offset by increased carbonisation.

The effect of oiliness on wear was tested with special bearings in which the rubbing pieces would be weighed on a chemical balance after 10,000,000 revs. The results given below give the total loss of weight in grams of both

parts of the bearing, the oils having the same viscosity (about 120 secs. Redwood I at 140° F.), the compounded oil figures being in *italics* :—

Rig No.	Test No. 1.	Test No. 2.	Test No. 3.	Test No. 4.	Test No. 5.	Test No. 6.	Test No. 7.
1	0·1414	0·0476	0·0286	*0·0224*	*0·0238*	*0·0390*	0·0329
2	0·0614	0·0398	0·0227	*0·0288*	*0·0295*	*0·0327*	0·0380
3	0·1434	0·0506	0·0223	*0·0415*	*0·0201*	*0·0295*	*0·0440*
4	0·0528	0·0410	0·0271	0·0328	0·0578	0·0478	*0·0389*
5	0·1113	0·0475	0·0267	0·0147	0·0369	0·0316	*0·0433*
6	0·0758	0·0462	0·0247	*0·0642*	—	—	—
7	0·0662	0·0602	0·0287	—	—	—	—

In Nos. 1-4 the journal was aluminium and the bearing bronze, and in Nos. 5-7 the journal bronze and the bearing white metal.

It is clearly established that an oiliness measurement cannot be relied upon as an indication of the general practical value of oil.

Carbonisation.—Laboratory tests have been proposed to determine the tendency of an oil to give carbon deposits, and take two forms, coking and oxidation. No test has been found to indicate the results to be expected from engines and laboratory conditions do not correspond to engine conditions.

Two mineral oils were tested on a single-cylinder bench engine, the walls of which were maintained at 185 to 200° C., for 50 hrs. over periods of 8 and 7 days respectively, hourly readings for deceleration being taken. Oil C had a sp. gr. at 15° C. of 0·911, viscosity Redwood I, 907 secs. at 100° F. and 81 secs. at 200° F., Ramsbottom Coke Test, 1·3. The sp. gr. at 15° C. of oil D was 0·938, its viscosity Redwood I at 100° F. being 931 secs. and at 200° F. 77 secs., the Ramsbottom Coke Test being 0·8. On laboratory tests oil D was the inferior. The results of the engine tests were :—

	Oil C.	Oil D.
1st day, average deceleration ..	454 ..	449
2nd „ „ „	(458) ..	454
3rd „ „ „	448 ..	(462)
4th „ „ „	438 ..	457
5th „ „ „	(436) ..	452
6th „ „ „	456 ..	455
7th „ „ „	449 ..	456
8th „ „ „	444 ..	—

The figures in brackets are the average of three decelerations or less. Some light is thrown on the superior performance of oil D by the carbonisation figures :—

	Oil C.	Oil D.
Oil consumption, pints	0·8 ..	0·6
Carbon on piston, grams ..	0·25 ..	0·08

It is not suggested that carbon on the piston is responsible for increased engine friction, but inspection showed that carbon on the piston walls was the decisive factor.

In order to obtain increased oiliness, deleterious substances are liable to be incorporated, and specifications involving oxidation tests also invite this. Oil C contained 44 per cent. of residual filtered cylinder stock, and oil D none.

Tests to investigate the effect of deposits in oil passages were made on a water-cooled single-cylinder 5·9 h.p. engine, fitted so that the lubricating

oil from the crankcase was circulated through a small centrifuge while the engine was running. The object of the test was to investigate the sludge deposits sometimes found in hollow crank pins. Four oils, E, F, G, H, were used and the "sludge" results showed the relationship between F and G to be the reverse of that indicated by oxidation. F, E and H were in line with laboratory results, but oxidation tests exaggerate the differences. Considering piston carbonisation, the coke test would place them in the order G, E, H, F, or F, G, E, H, while engine results placed them as H, G, E, F.

Laboratory tests at present in use not only exaggerate differences where they place oils in the right order of merit, but cannot be relied on to indicate the correct order. The only guide to lubricating quality is actual trial under engine service conditions.

Other Tests.—Specific gravity and flash-point are only indications of the origin of the oil.

Viscosity is frequently used by laying down "viscosity curve" requirements. Lubricating oils are commonly graded by their viscosities at moderate temperatures, as 100 or 140° F., and oils of different curves, matched at these temperatures, give equal consumption figures. The power output and friction of the single-cylinder sleeve valve engine mentioned above were measured with two oils. Oil M had viscosities in °E. of 46·0 at 20° C., 5·8 at 50° C., and 1·7 at 100° C., which Oil N gave 46·0 at 20° C., 8·2 at 50° C., and 2·0 at 100° C. With Oil M the B.M.E.P. varied from 100 lbs./sq. in. at 700 r.p.m. to 86·5 lbs./sq. in. at 2,400 r.p.m., the friction being 15·7 B.M.E.P. at 900 r.p.m. and 30·3 at 2,400 r.p.m. In the case of Oil N, the B.M.E.P. at 700 r.p.m. was 97.8 lbs./sq. in. and 85·0 lbs./sq. in. at 2,400 r.p.m., the friction being 17·5 B.M.E.P. at 900 r.p.m. and 31·8 at 2,400 r.p.m. The oil of steep viscosity curve showed a practically constant advantage of 2 per cent. in maximum power and 2 lbs./sq. in. in friction.

From the laboratory point of view, the judgment of oils by their viscosity relationships between 70 and 200° F. may be misleading. The viscosity curve should also be considered in relation to pour test. Two oils were examined, one (O) with a pour test (A.S.T.M.) of 45° F. and the other (P) of 10° F. Viscosity measurements at 32° F. and upwards showed oil O to have a measurable viscosity at 40° F. and the curves to cross at about 47° F. Oil P would be expected therefore to give easier starting.

The statement "the flatter the viscosity curve the better the oil" is already shown to be incomplete as a criterion of starting power.

Conclusions.—Research into the practical meaning of laboratory tests has shown:—

1. No substantial benefit is derived from compounding oil to improve "oiliness."

2. Present laboratory tests do not correctly evaluate the important factor of formation of decomposition products.

3. No justification is apparent for judging by viscosity changes above 70° F.

No progress can be made at present along laboratory lines without constant control by trials on actual engines. G. S.

307. The Microanalysis of Lubricating Oils. Meyerheim and Frank. *Refiner*, April, 1927.

In the determination of viscosities of oils, using the Engler or Redwood apparatus, the quantity of oil used is large and consequently necessary determinations are made impossible. The Vogel-Ossag viscosimeter is a modification of the Oswald capillary viscometer and used about 15 c.cs. of oil. A cylindrical vessel of small capacity is filled to the rim and covered with a

lid containing a capillary. Above the capillary and connected to it in series are two glass bulbs. Part of the oil is sucked up into the lower bulb and the lid secured tightly. A thermometer is now inserted into the air vent in the cover. The whole assembled apparatus is placed in a bath maintained at a temperature 6 per cent. in excess of the determination temperature, the oil sucked up into the upper bulb and allowed to remain there till in equilibrium and then the time taken to flow between two marked levels noted. The viscosity $V = \frac{T}{R}$ where T is time in seconds and R a predetermined constant for the apparatus.

Repeat determinations are thus easily and rapidly possible on the same sample, while determinations at different temperatures are made, starting at the lowest temperature and working upwards.

For flash point, determinations are carried out in a small porcelain crucible which is filled to within 6 m.ms. from its edge with the oil. The thermometer is placed in the centre of the crucible so that the bulb is in the centre of the oil and the test flame is passed to and fro while heating in the usual manner. 10 c.cs. of oil are necessary for accurate determinations. A. R. S.

308. Microscopic Study of Petroleum. F. W. Padgett, D. G. Hefley and A. Henriksen. *Oil and Gas J.*, 1927, **25** (52), 96.

The microscope is of sufficient importance to be indispensable in certain laboratory investigations, particularly of paraffin wax and wax-containing products. It is generally used in research work, but has been adapted to process control.

For refinery work, the microscope should be equipped for use of both ordinary and polarized light, for determination of crystal properties, observations under various conditions of illumination, and examination at magnifications of 1,000 or greater. As a combination instrument to meet the above requirements, the petrographical microscope could be used as a basis, including a revolving stage and Nicol prisms and a lens for determining interference figures. Further accessories would include extra objectives, a dark field illuminator and a portable adjustable lamp, and a special lamp for illumination from above. For the latter, the authors have found the Silverman lamp satisfactory.

Temperature control may be obtained by warm and cold stages. An electric current flowing through resistance wire embedded in the stage and suitably controlled provides the former, and for the cold stage cold water circulating through copper tubing similarly embedded may be used.

The hanging drop or recessed slide is generally more suitable for petroleum work, the sample being placed either in the recess or on the under surface of the cover glass.

The article is illustrated with photomicros showing the conditions of microscopic examination likely to be encountered. G. S.

309. The Production of Lubricating Oil from Coal. *Engineering*, 1927, **123**, 665-6.

The practicability of obtaining lubricating oils from coal is largely determined by the method of distillation adopted. The problem is within reach of solution provided the tar vapours are withdrawn before condensation in the retort can take place: and internal is therefore preferable to external heating.

A Shirebrook bastard cannel coal subjected to distillation in the Laing and Nielsen (L. & N.) plant gave a crude tar having the following constituents:—0°—300° C., 17·5 per cent.; 300°—350°, 14·6 per cent.; 350°—370°,

10·5 per cent.; above 370°, 45 per cent.; pitch 7·5 per cent.; loss 4·9 per cent. The 45 per cent. fraction b.p. over 370° was washed with caustic soda (20 per cent. phenols) and then refined with 3 per cent. of sulphuric acid. The refined oil was distilled, the first 25 per cent. being added to the kerosene fraction and the remainder pressed at —5° C. to remove wax. A subsequent distillation of the residue gave a wax-free lubricating oil of a rather dark red colour and a marked green fluorescence. The yield of all grades of lubricants amounted to 15 per cent. of the crude dry tar, not more than 4 per cent. being spindle oil.

A medium oil from the above had the following properties:—Specific gravity (18° C.) 0·981; flash point (closed) 415° F.; viscosity at 70° F., 1·525 Redwood secs.; at 100° F., 421 secs.; at 140° F, 124 secs.; at 200° F, 50 secs. This oil was subjected to friction tests at the National Physical Laboratory and results compared with those obtained with a petroleum oil lubricant having specific gravity (17° C) 0·901; flash point (closed) 420° F; viscosity at 70°F, 140° F and 200° F, 898, 121 and 55 Redwood secs. respectively.

At lower loads the seizing temperature of the L. & N. oil was little lower than that of the well oil, but at higher loads the L. & N. oil appeared to be more satisfactory. The coefficient of friction of the L. & N. lubricant was apparently less than that of the other oil at low loads and the same at high loads.

H. G. S.

310. The Petroleum Waxes. Buchler and Graves. *J.I. & E.C.*, June, 1927.

In refinery practise three waxes are met with, paraffin which is pressed from the lighter wax distillates and sweated free from oil, slop wax which is present in the heavier wax distillates and commonly considered unpressable, and petroleum wax, characteristic of residual stocks.

Since the observations of the refiner and the published literature are inadequate to explain the differing behaviour of the petroleum waxes in the processes of pressing, sweating, cold settling and centrifuging, this work was undertaken, it being desired to determine if all the waxes belong to the same homologous series.

Narrow cuts were therefore made on the various commercial waxes and by consideration of such physical properties as melting point, index of refraction and density to show a regular increase with increasing molecular weight. Each wax obtained was crystallized from ethylene dichloride at 40° F. to free it from oil and the product taken as definite when melting point and index of refraction were constant. These products were then distilled under a vacuum of 1 m.m. mercury.

The curves of physical constants and microphotographs all show that, irrespective of the type of wax, all belong to the same homologous series, namely, $C_n H_{2n+2}$. Combination analyses further support this view.

The form of crystal exhibited by all the prepared specimens of the pure cuts is definitely plate type in distinct contrast to the needle type of crystal hitherto considered characteristic. The size of crystal decreases with increasing molecular weight.

The factors governing the type of crystallization shown by various refinery stocks are the viscosity of the oil and solubility and molecular weight of the oil, and secondly, of greater importance, the content of "soft wax." A. R. S.

311. Colour of Lubricating Oils in Acid Stage. Kauffman. *Refiner*, April, 1927.

The exact action of sulphuric acid in the treatment of asphaltic base crude lubricating oil is not exactly known, but the factors which seem most

to influence efficiency in washing are temperature of treatment, method of mixing acid and oil, number of separate acid treatments in total washing and the length of time acid and oil are in contact. This last factor is directly dependent on the method and violence of agitation, size and shape of agitator, viscosity of the oil and relative quantity of acid used. Usually acid of from 93—98 per cent. is used, but certain practises prefer to utilize waste acid of lower concentration for the initial stages. Water contained initially should be removed by agitating for 5 minutes with from half to one pound of acid per barrel of oil, after which the main treatment of from 4 to 16 lbs. per barrel is given in two stages with agitation till the desired colour is obtained. The sludge is now settled by addition of either weak soda solution or water in small quantities so as to avoid the formation of large lumps, and washing is continued with dilute alkali till sufficiently neutral products are obtained. Data given show that the colour of the oil in the last acid stage is usually better than in the finished product. This is explained by supposing the resolution of small quantities of sludge coupled with oxidation in the air. A. R. S.

312. The Composition and Chemical Constitution of Lubricants (Oils) and their Synthesis. A. Spilker. *Petroleum*, 1927, **23**, 448-451.

The high molecular weight (350) of viscous machine oils leads to the supposition that polycyclic naphthenes are present with some 25 carbon atoms. The analysis of lubricants, on account of its difficulty, was replaced by synthetic research on the building up of highly viscous substances, and attention was directed to the high molecular substances obtained by addition from olefine products with double linkages. The viscosities E, at 50° C. of addition and condensation products of benzene homologues was found to be: from toluene-styrene, 0·4, xylene-styrene 0·6, pseudocumene-styrene 1·2, toluene-allyl alcohol 0·9, xylene-allyl alcohol 2·2, and pseudocumene-allyl alcohol 16·2. The attachment of methyl groups to the aromatic rings greatly increases the viscosity. The normal hydrocarbon chains possess little viscosity, while the *iso* compounds are distinguished by high viscosity. Experiments were made with reduction products from coal and coal tar with the Bergius process, with lower temperatures and in the presence of finely divided nickel. Engler viscosities at 50° C. were found, for the products of hydrogenation of acenphthene 0·5, phenanthrene 0·6, anthracene 0·4, fluoranthene 1·8, pyrene 2·3, naphthofluorene 3·1, and chrysene 4·5. The polyhydrides of chrysene have all the characteristics of lubricants, but they are not identical with those of petroleum oils, as the sp. gr. is over 1, the gravity of petroleum lubricating oils ranging from 0·9 to 0·98 in cylinder oils. By hydrogenation of coal and coal tar products substances ranging in viscosity Engler at 50° C. from 2 to 16 were obtained. The hydrogen content of these hydrogenated products was higher than that of natural Russian lubricating oils. The very high molecular weight of substances derived from pitch favours the formation of highly viscous hydrogenation products. H. M.

See also Abstracts Nos. 282, 284, 316 and 323.

Special Products.

313. Bitumen Emulsions for Roadmaking. Albrecht von Skopnik. *Petroleum*, April 20, 1927.

A concise summary of the early patents for bitumen emulsions is given. The opinion is given that the bitumen must be applied in the most finely divided state possible subject to the viscosity required. The bitumens

most used are natural asphalts or those obtained from crude petroleum and coal tar. Petroleum pitch has good spreading qualities and by admixture with anthracene oil and coal tar its adhesive properties are enhanced. The viscous anthracene oil polymerises through time thus binding the surface to a greater extent. A. R. S.

314. Fluorescent Oil and Process of Making Same. L. Lilienfeld. U.S.P. 1,625,415. April 19, 1927.

The invention provides for aromatic hydrocarbon mixtures such as solvent naphtha, crude benzol and the like being treated with a polymerising agent such as sulphuric acid and washed to neutrality. This is then freed from constituents boiling below 180° C. at atmospheric pressure and the residue distilled under a vacuum of 15 mm. of mercury, preferably with the aid of steam. The following fractions distil over: between 90° and 130° C naphthalene and the naphthalene oils, between 130° and 180° C. slightly viscous condensation products and between 180° and 300° C. the viscous oily bodies of high boiling point claimed in the invention. This last fraction may be purified by redistillation and is then obtained as a water-white to light yellow, viscous oil of slightly blue fluorescence and consists almost completely of saturated hydrocarbons of the aromatic series. The yield is approximately 6—15 per cent. according to the quality of the starting material. S. W. C.

315. Improvements in or Relating to the Composition of Bituminous Mixtures for Use in Road Construction, Maintenance and Repair and for Other Purposes. E.P. 246,186. Jan. 26, 1926. Universal Rubber Paviors, Ltd., and A. E. Brown.

Bituminous mixtures for use as road dressing, filling between setts and general surfacing are made by removing the hygroscopic water from clays, marls, shales, aluminous infusional earths, etc., by heating at 300—400° C., and then grinding till 95—98 per cent. passes through a sieve containing 40,000 holes per sq. in. This filler is then mixed with the bitumen, of which it absorbs up to 45 per cent. by volume by slow stirring at 450 ft. peripheral speed per minute at 5 ft. diam., at a temperature of 80—100° C. It is claimed that bituminous suspensions thus prepared are more adhesive than known mixtures and do not peel off when cold. A. R. S.

Analysis and Testing.

316. Method of Determining the Acidity of Dark-coloured Petroleum Products, and the Acidity of Crude Grozny Oils. By N. A. Smirnof. *Azerbaidj Neft-Chaz.* **52**, 66–9 (1926).

The method consists of adding to 10 gms. of the oil, 50 ccs. of 0·5 N alkali in alcoholic solution, shaking for 10 minutes, and then adding 300 ccs. of petroleum ether. The mixture now consists of two layers, a petroleum ether-oil layer on top, with the alcoholic solution below. The upper layer is washed with 80 per cent. alcohol until the washings are neutral, and the lower layer is washed twice with petroleum ether. The washings of the alcoholic layer are added to the petroleum ether solution, while those from the latter are added to the alcohol solution. The alcohol is next distilled off from the alcoholic solution, and the residue taken up with 30 per cent. sulphuric acid. The naphthenic acids liberated by the acid are extracted with ether, and the ether subsequently removed by distillation. The residue is now taken up with 200 ccs. of petroleum ether and 5 ccs. of benzene, 400 ccs. of distilled

water are added, and the solution titrated cold with $\frac{N}{10}$ alkali with phenolphthalein as indicator.

The advantages of this method are firstly, that the titration is carried out in the absence of easily oxidisable materials such as alcohol and ether, secondly, that the solution is colourless, thirdly, that the end point colour is stable, and, lastly, that the extraction of acid is complete. The method suffers from the disadvantages of the titration being carried out in aqueous solution, and of the possibility of hydrolysis of naphthenic acids. W. H. T.

317. Determination of the Asphaltum Content of Mineral Oils. J. Marcusson. *Chem. Ztg.*, 1927, **51**, 190.

A crude oil from Wietze gave the following figures for asphalt content with different precipitant media: benzine, 0·9 per cent.; alcohol-ether, 5·2 per cent.; acetic ether, 5·4 per cent.; amyl alcohol, 22·4 per cent., and butanone, 5·7 per cent. It is assumed that the asphaltene or hard asphaltum is insoluble in benzine, but a certain amount is dissolved with the oils. The substance precipitated by amyl alcohol contains a mixture of hard asphaltum, petroleum resins and hydrocarbons. The tests in general use are neither concordant nor accurate. It is proposed to use a method in which an ethereal solution of ferric chloride is the medium. 5 g. of oil are dissolved in 50 cc. of ethyl ether and 5 cc. of a 5 per cent. ethereal solution of ferric chloride added. After two hours standing the precipitate is filtered off and washed with ether. The precipitate is then extracted with boiling ether till no more oil is extracted, and then dissolved in warm chloroform. To the solution 5 cc. of diluted hydrochloric acid and 5 c.c. water are added, it is agitated, evaporated to dryness, and weighed at 105° C. The method presents a ready and cheap method of quantitatively determining the hard asphaltum. H. M.

318. The Coalescence of an Unfilterable Precipitate of Barium Sulphate. H. M. Trimble, *Journ. Phys. Chem.*, 1927, **31**, 601.

The aggregation of small unfilterable particles of barium sulphate on digestion with very dilute hydrochloric acid at 100° C. has been studied in the light of Ostwald's hypothesis that the solution pressure of small particles of a substance depends inversely on the size of the particles. Particles of barium sulphate of more than two microns diameter show no tendency to pass into larger ones even on prolonged digestion under these conditions. Hence the solution pressure of particles of this size ceases to be a function of the diameter, although for smaller particles the rule seems to be followed.

It is suggested that the coalescence of an unfilterable precipitate is due to preliminary aggregation of the small particles followed by cementation of the aggregates by fresh barium sulphate from the supersaturated solution. If the digestion of the precipitate is accompanied by stirring aggregation is inhibited. Microscopic examination of the precipitate supports this view.

R. P. L.

319. A Gauge for the Measurement of High Vacua. By Robert E. Burk, *J. Phys. Chem.*, 1927, **31**, 591.

The disadvantages of the existing high vacuum gauges for dealing with chemically sensitive gases are discussed.

The new gauge combines the principles of the common manometer, the McLeod gauge and the quartz fibre manometer and has been tested to 1×10^{-6} mm. of mercury. It can be used as an ordinary McLeod gauge for pressures from 0·00885 mm. to the range of the ordinary manometer and this can be

used for pressures up to atmospheric. The apparatus as a whole will thus read pressures from 760 to 1×10^{-7} mm. of mercury. R. P. L.

320. The Importance of Hydrogen Ion Estimation in Volumetric Analysis. Britton, *Ind. Chem.*, May, 1927.

The paper deals first with the practical significance of the dissociation constants of acids and bases, and deals with the variation in p-value during the neutralisation of acids and bases.

The importance of choice of indicator is illustrated in the case of titration of alkaloids. The basic dissociation constants of the alkaloids also supply information which may be of use in effecting their separation. In the case of a mixture in an organic solvent of two alkaloids of widely differing dissociation constants, on treatment with alkali, the salt whose alkaloid has the smaller dissociation constant will first be reached upon and then dissolved in the solvent, before the second salt becomes decomposed. By using a solution buffered to within a small p-range, instead of free alkali, prevention of extraction of the second base will be achieved.

In the case of Ampholytes or amphoteric bodies, Sörensen found that if excess of neutralised formaldehyde be added to the ampholyte titration of the carboxyl group with phenolphthalein became possible. Boric acid, ordinarily an extremely weak monobasic acid, may be titrated in presence of glycerol or mannitol and phenolphthalein, although alone the colour change takes place when between 10 per cent. and 20 per cent. is neutralised.

Acids and bases, too weak to be estimated volumetrically, can be estimated potentiometrically. In the case of an acid in which its degree of dissociation α is so small as to be negligible

$$K_a = [H^+] \times \frac{[\text{salt}]}{[\text{acid}]}$$

Similarly for a base

$$K_b = [OH^-] \frac{[\text{salt}]}{[\text{base}]}.$$

In the case of moderately weak acids and bases, the salt formed was equivalent to the titrant added, but this was far from true with extremely weak acids and bases. The salt concentration can be calculated from the amount of titrant added, and the hydrogen ion concentration, for the latter concentration is set up solely by the amount of titrant which has failed to react. Hence, knowing the degree of dissociation of the titrant when in the concentration indicated by the p-, the amount failing to react can be calculated, and this subtracted from the total amount of titrant gives the amount combined with the acid or base. A. R. S.

321. Effectiveness of Laboratory Rectifying Columns. Marshall and Sutherland. *J.I.E.C.*, June, 1927.

The ordinary unfilled laboratory column separates almost entirely by partial condensation, while a filled column separates by partial condensation at the top and rectification for a short distance from the bottom.

The relative efficiencies of lagged and unlagged columns of the Hempel type with controlled reflux, operated by the return of a known quantity of the overhead distillate, and working at various throughputs, were determined using the equation of Lewis in the form modified by Peters; i.e.,

$$x_{n+1} = \frac{y_n - (1-\rho)x_0}{\rho}$$

Where x_{n+1} = mol. fraction of more volatile component in the liquid on the (n+1)th plate.
y_n = mol. fraction of the more volatile component in the vapour over the n^{th} plate.
x_0 = mol. fraction of the more volatile component in the distillate.
ρ = the ratio of overflow in mols. per unit time from one plate to the next, to mols. of vapour per unit time passing up the column.

In this equation the reflux ratio equals $\frac{\rho}{1-\rho}$.

The liquids chosen in this case were alcohol and water, partly because so much is known of the distillation of this mixture and partly because analysis by density is so simple.

The conclusions drawn are that for sharp cuts, columns such as those of Peters and Lealie are most efficient, while for the purification of quantities of material, an ordinary packed lagged jacket with controlled reflux from overhead distillate is equally effective.

The effectiveness of a properly lagged Hempel column 99 cms. long, with maximum reflux is 2·4 to 41·5 times as great as that of the same column unlagged and operating at the same distillation rates. This improvement factor increases for low concentrations of the more volatile component and high distillation rates.

A. R. S.

322. A Simple Continuous Extraction Apparatus. Clark. *I. and E. C.* April, 1927.

The bottom of a pharmaceutical percolator is fitted with a tube and stop-cock connected to a flask. From this flask another tube passes through a Liebig condenser back to the top of the percolator through a vapour-tight lid containing also a reflux condenser. Extraction proceeds when the solvent is boiled in the flask. With high boiling solvents the Liebig condenser is filled with steam.

A. R. S.

323. Iodine Colour of Petroleum Products. Davis. *Oil and Gas Journal*, May 12,

The method detailed is applicable to crude petroleum, lubricants and the darker petroleum products, and is a modification of the Cross method using a solution of 10 gms. iodine and 10 gms. potassium iodide per 100 gms. solution. Control tests were difficult to obtain with this solution owing to its unstable nature and so a graph was drawn up connecting Tag-Robinson colour values with various concentrations of the above solution expressed in mgms. Iodine per 100 ccs.

1 c.c. of the product under examination is diluted to 2, 5, 10 or 100 ccs. with standard colour benzene and its Tag-Robinson colour determined. This colour is now converted to mgm. Iodine per 100 ccs. by means of the graph and the result multiplied by 2, 5, 10 or 100 according to the dilution.

A. R. S.

324. Improved Process for the Catalytic Combustion of Explosive Gaseous Mixtures. I. W. Cederberg. E.P. 236,145, Jan. 18, 1926.

The backfiring of the explosion of an explosive gas mixture is prevented by passing the mixture at high velocity through a small contact space, of

about 1 mm. width, between the inner wall of the contact apparatus and the catalyst arranged therein in the form of a solid cylinder. The method is particularly adaptable to the combustion of ammonia-oxygen mixtures, which may be ignited at the moment of discharge from the annular space referred to with only momentary explosion. The explosion flame is extinguished and is followed by catalytic combustion. R. P. L.

See also Abstracts Nos. 286, 304, 307, 308, 390, 391, 406 and 410.

Refinery Plant.

325. Isometric Maps Make a Picture of Refinery Piping. H. H. Kelly. *The Refiner and Natural Gasoline Manufacturer*, Feb., 1927, 53.

It is recommended in making maps of general lay-out of piping in refineries that, in places where the exact positions of valves and cocks are not at once obvious from the plan view, isometric views should be drawn to a larger scale showing the exact positions of bends, tees, valves, etc. Such isometric views are more readily understood by the ordinary mechanic and copies should be hung in the pump house and similar places so that a glance at the map will show what valves should be opened or closed to effect any transference of oil.

In addition the isometric view conveys a clearer idea to the engineer in charge of the actual lay-out of the piping, and may afford considerable help in showing what modifications would reduce pumping power lost in friction. E. R. B. S.

326. New Developments in Fractionation. C. L. Smith. *Oil and Gas Journ.*, Feb. 17, 1927.

A distillation unit is described for which there is claimed great flexibility, freedom from small auxiliary pumps, condensers and heat exchangers. The plant is compact and of high thermal efficiency, and very close cuts are obtainable. It consists of a tube still, vaporisation chamber and three large towers. Near the tops of the towers, sets of reflux tubes are fitted, while near the bottoms reboilers are fitted. The fractionating spaces between these are fitted with trays of trough shape, stamped from steel, while at intervals between these are fitted distribution pans, designed to prevent channelling.

The cold charge is pumped through the reflux coils and then to preheater bank, whence it passes into the main heating bank. It is discharged into the vaporiser and the unvaporised part pumped off and passed to the bottom of the second tower. The condensed oil from the first tower is drawn off through a coil in the bottom of the second tower. By varying the amounts of crude and fractions obtained pumped through the reboilers and refluxers the actual compositions of the fractions can be altered.

A. R. S.

327. Measuring and Calculating Outages. John Stumpf. *Oil and Gas J.*, 1927, **25** (48), 86, 108, 110.

Outage claims on tank-car shipments are expensive to handle, and although the present average of such claims is only about 1 in 50, this could be further reduced if the consignee knows how to check correctly.

Until recently loaders of tank-cars have used their own coefficients of

expansion, but during the past year or so the principal firms have adopted the Bureau of Standards table, as follows :—

Grade.	Degrees A.P.I. at 60° F.	Coefficient of expansion per °F above or below 60° F.
Crude, road oil, flux, lubricating and gas oil, etc.	Up to 34.9 ..	0·0004
Crude, gas, fuel or lubricating oil, kerosine, etc...	35 to 50·9 ..	0·0005
Gasoline	51 to 63·9 ..	0·0006
Gasoline, casinghead, etc.	64 to 78·9 ..	0·0007
Casinghead	79 to 88·9 ..	0·0008
Casinghead	89 and over ..	0·00085

In taking outage measurements a proper outage gauge should be used and measurements made at the centre and outside edges of the dome to get the correct height if the car is not level.

For all practical purposes the temperature at the exact centre of the car is correct, but if absolute accuracy is required the temperature should be taken at 1 ft. from bottom, 1 ft. from top and in the centre. The centre temperature is multiplied by 8, added to the top and bottom figures and the whole divided by 10, the result being the correct temperature as near as it is possible to get it.

Cars should be checked immediately on receipt and should be carefully examined for any signs of leaks or tampering. If the car number is different to that invoiced, indicating a transfer in transit, instructions from the shipper should be obtained before unloading. An outage claim should not be made before the figures have been checked twice, and claims should not be made for less than 50 gallons. G. S.

328. Causes, Places of Attack and Methods of Combating Corrosion in Refineries. Perkins. *Oil Age*, April 27.

A general discussion of the causes and effects of refinery corrosion is given, and then the relative merits of protective coatings are discussed. A compound of wax tailings of high melting point with chromium is reputed to give good results, but its use is limited as it melts at about 130° F., cannot be walked on and dissolves in oil. Of metals sprayed on to tubes to a thickness of 0·002 inch aluminium appears most promising.

A. R. S.

329. A Symposium on Corrosion. Seventh Annual Meeting American Pet. Inst., Dec., 1926.

1. Corrosion of Pipe Lines. E. C. Kincaide.

This is very much a factor of the kind of soil through which the pipe must pass. The value of painting underground piping is a very vexed question and the writer is of the opinion that the use of any paint is a doubtful measure. In general little or no corrosion occurs where the pipe is laid through sand or gravel which allows the water to drain away freely, while in clay which in dry, hot weather expands away from the pipe, leaving a space for water to collect, much corrosion is to be expected.

2. Protecting and Reconditioning Underground Pipe Lines. C. R. Werdner.

The writer divides corrosion into three classes. The first is characterised by uniformly distributed scale over the entire length of the pipe and resembles

atmospheric corrosion. When badly corroded the scale sloughs off in thin layers. The second type is characterised by rather shallow and uniformly distributed depressions, resembling somewhat a sheet of copper that has been ball peened. The third type is known as pitting and is most prevalent. It is distinguished by deep depressions often of irregular shape and size, which eventually perforate the metal causing leaks. Such pitting is the great source of trouble in pipe lines. Four suggested methods of combating corrosion are, by insulating and grounding the pipe against electrolysis; by modifying corrosive soil conditions; by manufacturing material more resistant to corrosion and by use of protective coatings.

In the second class the use of slaked lime alone or in combination with sand has been shown to have good effects, while in wet soils the laying of the pipe on a coating of highly porous material has lessened corrosion. As regards available protective coatings there are five types available. These are paint, bitumen, fabric reinforced with bitumen, Portland cement, metal. The essential fundamental quality of these is that they must effectively seal the pipe from contact with corrosive agents. In all cases where bituminous paint is used the pipe must be cleaned of all loose mill scale, rust, dust and traces of oil and grease. After this the surface must be perfectly dried immediately before application. In general, red lead, zinc and graphite paints are not of much use on account of their porous natures and low adhesive powers. Paints with a coal tar or asphaltic base are most frequently used, commercial varieties containing one or more of the following ingredients, air slacked lime, tallow, resin, cement, para rubber, gilsonite, silica, soapstone, China wood oil and chromates. This coating is thinly applied and in more recent practice this is again coated with some paint reinforced with a filler such as asbestos fibre, the whole making a thick impervious coating.

Where purely bituminous coatings are used these are generally applied by dipping or mopping, the bitumen being in the molten state. Where corrosion conditions are severe the pipe is next wrapped in fabric saturated with bitumen and another coating is poured on top.

By far the most lasting, if expensive, coating is Portland cement. The pipe is first given a thin bituminous coating and then the cement applied with the use of steel forms in which the pipe has been centred. An aggregate of clean sand in the proportion of two to one has been used. Pipe lines in salt marshes have been protected in this way for twenty-five years with little maintenance.

A metallic coating to be serviceable must be anodic to iron and this and the high cost of application has limited the use of these coatings.

Before applying any coating, whether to new or reconditionable pipe, the following economic factors must be considered, the service life of the pipe line, the physical life of the pipe, the physical life of the protected pipe, the cost of the pipe line, the cost of the protective coating, the cost of repairs and the future cost of replacing the pipe line.

3. Protective Coatings. E. M. Converse.

The use of thin readily applied coatings is preferred to the thicker variety, and while the value of films of purely mechanical nature is not denied, it is thought that the presence of a chemical corrosion inhibitor would go a long way to solving the problem. The coating should also be elastic as many of the drying films at present in use do not adhere to the metal but leave an annulus of air between the pipe and coating.

4. Corrosion in Oil and Gas Wells. R. Van A. Mills.

Wells are likened to galvanic cells in which the casing, tubing and pumping equipment are the electrodes and salt water the electrolyte. Gases in solution

such as H_2S and CO_2 materially increase this corrosion. If, when the well is being drilled, an analysis of the water encountered is made, much could be done to prevent corrosion by the use of more suitable material.

5. Corrosion of Pipe Lines. E. R. McCarthy.

Thick bituminous coatings give adequate protection for underground pipe lines.

6. Paint as a Protective Coating. H. B. Einbecker.

This paper refers primarily to above ground equipment and the importance of thoroughly cleaning the metal surface either by sand blasting or pickling is stressed. The surface must then be entirely freed from moisture. The priming coats most in favour contain a considerable percentage of basic lead chromate mixed with iron oxide or silicates. This coating should be evenly applied, need not be of any great thickness, and should be allowed to dry from 48–96 hours. The second coating need not be highly inhibitive, but should contain no salts likely to be affected by H_2S.

7. Theories for Corrosion and the Modern Method of Combating it. C. B. Callomon.

The old theory that rusting is always caused by free carbonic acid is shown to be wrong in view of the fact that iron will rust when immersed in dilute alkali. Nowadays it is thought that water in some form must be present in all cases of normal corrosion. The presence of salts dissolved in the water increases the hydrogen ion concentration and it is through these that corrosion actually starts. The speed of corrosion may be said to be directly proportional to the hydrogen ion concentration, within certain limits. In perfectly still conditions the surface of the iron becomes covered with uncharged hydrogen bubbles, i.e., ions which have given up their charge on coming into contact with the metal, and these prevent any further ions getting to the surface, thus arresting corrosion. As the iron is subjected to contact with hydrogen ions it becomes ionized and the double positive charge is neutralised by the hydroxyl ion present due to the dissociation of the water, forming ferrous hydroxide. Where the water is in motion the film of hydrogen bubbles is swept from the surface and the corrosion proceeds normally. The presence of oxygen in solution also keeps up the corrosion rate, the oxygen uniting with the hydrogen bubbles to form water.

As regards the metal itself, pure iron corrodes at a slower rate than steel. To a certain extent this may be said to be due to its lower solution pressure, but also the presence of other metals and non-metallic elements in the steel sets up parasitic currents and consequently the corrosion is accelerated. Metal which has been strained in fabricating is less able to stand up to corrosion than unstrained metal. Likewise rough surfaces presenting more surface per unit area than polished surfaces are likely to be more attacked.

8. Tank Corrosion. L. G. E. Bignell.

The subject is subdivided under the three headings, outside rusting of deck and sides of tank, outside rusting of bottoms, interior corrosion due to electrochemical action and accelerated by hydrogen sulphide.

Corrosion is usually most marked at the edges of the plates used to cover the tanks due probably to the accumulation of water. When the atmosphere carries noticeable amounts of H_2S or SO_2, there is usually marked corrosion of the outsides of the tanks, undoubtedly due to the action of these gases.

The second condition which deals with the corrosion of outsides of tank bottoms is very similar to the action on pipe buried in the ground. Where

the soil is likely to attack the tank bottoms, some protection should be given. Some companies prefer to prepare the ground with viscous heavy oil or still bottoms free from sulphur and provided this is not washed away by water, the protection is adequate. Otherwise, the tank bottoms may be asphalted and covered by dipped asbestos sheet before assembly, the bolt or rivet heads being finally coated by brushing from underneath. Cement settings serve well provided there is no air space between the cement and the tank bottom.

As regards the third class of interior corrosion, if H_2S is absent much can be done to prevent or retard this by the use of a suitable paint insoluble in petroleum products. Where much H_2S is present the life of the tank is proportionally shortened. Oils produced from limestone usually show a greater sulphur content than those from sand, supposedly due to migration of the oil from where it was originally formed and consequent filtration of sulphur from the gas and oil.

This hydrogen sulphide present in the oils in storage becomes concentrated in the water round the tank edges above the oil layer and dissolves in it. Oxidation and consequent precipitation of sulphur on the iron follows, resulting in iron sulphide scale. The analysis of a scale given shows this to be almost solely a mixture of sulphur and iron sulphide. When this scale falls from the tank roof on to the bottom it sets up a galvanic action in connection with the bolts and the steel bottom causing further corrosion.

9. Interior Corrosion of Oil Flow Tanks in Fields where the Sulphur Conditions are Bad. R. L. Ginter.

Brine drawn from an oil tank containing some sulphide scale was put into contact with low copper steel discs. In the case where the brine had been previously freed from scale the corrosion was much less than where the scale was present. This is taken as an indication that steel was electropositive to the sulphide deposit.

Quantitative work was carried out, using steel discs at the surface interface of brine and oil, and also by formation of galvanic cells, using polished copper steel pole and tank scale as electrodes.

The results of these show that accelerated corrosion is due to the formation of a galvanic couple, the steel being electropositive with respect to the H_2S corrosion products. As methods of combating this corrosion are given painting after thorough cleansing, removal of H_2S by chemical means, and trapping out all the scale formed in the pipe lines by mechanical means before this reaches the inside of the tanks. Cement linings are also suggested and illustrations given of treated pipe which has been for forty years in contact with water. The coating is claimed to be now friable.

10. The Action of Sulphur on Steel Tanks Containing Crude Oil. E. G. Woodruff.

Iron sulphide and sulphur are electronegative to iron and therefore tend to accelerate corrosion.

11. Corrosion of Equipment in the Gulf States. O. N. Edgar.

Although tanks painted with white or gray pigments rarely have a life of more than one year without renewal, the writer is of the opinion that properly applied aluminium paint stands up for at least five years, and that its heat reflective power is great. Failures are generally due to the failure of the priming coat and no data are available for a primer which has outlasted the finish coatings. Properly prepared aluminium paint which leafs perfectly will exclude the destructive elements and will furnish a real protection and unbroken film for a period of at least six years. A. R. S.

330. Process of Separating by Vacuum Distillation the Most Volatile Constituents of a Mixture of Liquids. A. Schmalenbach. E.P. 269,052. April 14, 1927.

The invention is an improvement on No. 244,726, and provides for a vacuum pump being connected to both the cooler and the rectifying column, the higher vacuum effect in the still and cooler being produced by using steam in the distillation. S. W. C.

331. Process and Apparatus for Condensing, Treating and Washing Hydrocarbon Vapours. C. W. Freeland. U.S.P. 1,627,431. May 3, 1927.

The invention provides more especially for condensing crude oil vapours. The apparatus consists of a condensing tube having an entrance end communicating with a vapour supply. The discharge end carries a collar in which is slidably fitted for longitudinal adjustment a collecting pipe that extends into the tube and may be locked in any longitudinally-adjusted position by means of a packing gland. For introducing water, two pipes are provided which extend into the tank at a point adjacent to the entrance end and have right-angular branch portions disposed in spaced relation to the inner wall of the tube. The branch portions are perforated so as to effect the discharge of the water in fine streams, the arrangement being such as to force the water at right angles to the length of the tube and cause a rotary circulation of the water therein. This rotary circulation of the water is in the direction of the discharge end of the tube and is such as to form at the axis of the whirl an opening which is co-axial with the tube and also the inlet and outlet pipes, and it is on the inner surface of this whirling body of water that the major condensation takes place. The water is discharged from the tube into a settler. Provision is made whereby a treating agent can be added to the water and the condensate thereby treated at once. The condensate flows out through the adjustable collecting pipe. The diameter of the collecting pipe is the same or slightly greater than the diameter of the vortex so that the condensed vapours may be collected without an appreciable amount of water. S. W. C.

332. Coking Still. R. Cross, Assr. to Gasoline Products Co. U.S.P. 1,622,573. Mar. 29, 1927.

The invention provides for a rotating still with a carbon basket suspended from its axis. This axis is prolonged so that when the end of the still is removed the carbon basket may be easily withdrawn. To one edge of the basket is attached a scraper whereby the coke is removed from the side of the still as it rotates and is collected in the basket. Means for removal of the vapours are provided. and the outside of the still carries heat-conducting vanes. The still must not be charged above the level of the bottom of the basket.

It is claimed that the heat-conducting vanes and the scraper provide better and more uniform heating of the oil. Also that the carbon collected in the basket is soft, flaky and easily removed, and this does away with digging it out of the still by manual labour. S. W. C.

333. Apparatus for the Treatment of Impure Petroleum Oils. J. D. Brady. U.S.P. 1,628,574. May 10, 1927.

The emulsified oil is fed in at the top of a vertical cylindrical tank. In this tank there are two mechanically operated stop-valves which begin to

function at predetermined levels. Two baffles are fitted, one immediately above the upper opening for the light oil and gas and the other above the tubular heating unit. A draw-off cock in the bottom of the tank serves to draw off silt and separated water. A. R. S.

334. Refining Oils. Parker. U.S.P. 1,627,338. May 3, 1927.

The plant is designed to provide a preliminary soda-wash for petroleum by the counter current flow of alkaline sodium hypochlorite solution, the spent solution as regards available chlorine being used for preliminary washing as caustic soda solution, the two treatments being continuous. The oil and reagent are mixed by means of orifice mixers connected to settling towers of conventional design. A. R. S.

335. Process of and Apparatus for Treating one Liquid by Another. Dickey. U.S.P. 1,625,195. April 19, 1927.

In a series of superimposed substantially closed interconnected tanks, the liquid to be washed, which must be of lower specific gravity than the washing fluid, is introduced under pressure through an injector arrangement through which it comes into intimate contact with the wash liquor, which enters at the top tank, is kept at predetermined level in each tank and finally flows away through a check valve at the bottom. The treated liquid flows away at the top. A. R. S.

336. Process of Treating Impure Crude Oil. Wright. U.S.P. 1,627,072. May 3, 1927.

In a totally enclosed apparatus steam and the oil are introduced under pressure as impellers to a turbine rotor to which is connected a vertical shaft fitted with paddles and a helical screw agitator. Thus the oil and water pass downwards to the bottom of the tank, the water removing sediment and other objectionable matter in its flow. An abrupt change in direction and passage through small orifices tend to break any emulsions formed and the mixture passes to a settling tank. A. R. S.

337. Method of Refining Petroleum. W. E. Lummus. U.S.P. 1,628,552.

The lower boiling fractions obtained in petroleum distillation are difficult to condense and are lost together with bubbles of higher boiling fractions held in suspension.

This patent describes a method of distillation which reduces these losses.

The apparatus consists of a still, a column fitted with trays, a condenser, which acts as a preheater, a second condenser which is cooled by water, and a gas scrubber.

The oil enters through the first condenser, where it is preheated, from where, passing on to a tray midway up the column, it flows down into the still through a return pipe.

From the still the vapours pass through the column to the first condenser; part of the condensate is used as reflux material for the column and the rest is collected. The uncondensed vapours pass on to the second condenser and here again part of the condensate is used as reflux material, the rest being collected. The uncondensible vapours flow into the bottom of a scrubber down which some of the condensate from the first condenser is passed and are either condensed, absorbed or dissolved.

Several other similar arrangements are described by which vapours are dissolved in a nonadjacent condensate. K. B. R.

338. Process of Separating Hydrocarbon Fractions. D. Pyzel, Assr. to Simplex Refining Co. U.S.P. 1,622,737. Mar. 29, 1927.

The process consists in passing vapours from a still into a dephlegmator down which flows cold condensate pumped from the re-run still. This cold condensate acts as both a cooling and an absorbing agent. The hot condensate from the bottom of the dephlegmator is led to a re-run still, composed of two end chambers connected by pipes running through the central chamber. The major portion of the condensate enters one end chamber, flows through the pipes to the other end chamber, from which it is withdrawn, passed through a cooler and returned to the dephlegmator. The minor portion enters the central chamber where, with the addition of steam and by heat drawn from the major portion flowing through the pipes, it is distilled, the low boiling-point hydrocarbon being driven off.

It is claimed that by this method a fraction can be withdrawn from the central portion of the re-run still, which boils between definite limits of temperature. Also the low-boiling point hydrocarbons, which are usually valuable, can be collected. S. W. C.

339. Oil-Separating Apparatus. Little and Sherman. U.S.P. 1,623,691. April 5, 1927.

This consists of a boiler-like casing containing a fire-box structure equipped with flues leading through the bottom portion of the casing. Above the flues is a perforated crown sheet through which the crude oil is forced, causing it to be split up into a fine stream. After the oil has passed through the heater it is chemically treated in the plant and then finally passes through a separator, which eliminates gas and water before the oil passes to storage.
A. R. S.

340. Process and Apparatus of Dephlegmation. J. D. Seguy, Assr. to Universal Oil Products Co. U.S.P. 1,623,136. April 5, 1927.

An ordinary cylindrical dephlegmator with the usual perforated baffle plates is described. A liquid draw-off is placed at the bottom and others at varying heights up the side, all being connected by a manifold to a pump. By this means the height of the liquid level can be varied. Vapour inlets are placed in corresponding positions up the side of the dephlegmator so that vapour can always be introduced just above the liquid level. Spray inlets are also provided for raw oil and condensate from the escaping vapours.

It is claimed that this invention allows the capacity of the dephlegmator to be altered to suit the requirements of any one vapour, this being impossible with dephlegmators at present in use. S. W. C.

See also Abstracts Nos. 287, 291, 298, 303, 319, 342, 345, 405, 412, and also those under the heading of Cracking.

Engineering.

341. Some Notes on Petrol-Engine Development. H. R. Ricardo (*Automobile Engineer*. April, 1927. Paper read before the Institute of Automobile Engineers).

A sense of proportion is advocated in designing the petrol engines of the future; the average life of an engine is taken as five years, therefore the first cost of production must be balanced against the economies in fuel consumption, etc., which the engine is designed to give. Curves are given showing the relation between increasing compression ratio, fuel consumption, brake horse power and surplus heat flow, provided the fuel does not cause pinking in the engine. Thus, at a compression ratio of 3·5:1, the engine requires

0·68 pints per b.h.p. hr., it developed 25·6 b.h.p. at 1,500 r.p.m., surplus heat flow is 8,400 B.Th.Us per b.h.p. hr.; at 7·0:1 the values respectively become ·43, 34 and 4,500. If pinking occurs however, the heat flow rises with very great rapidity.

To suppress pinking the following means are available:

1. Addition of organo-metallic dopes.
2. Addition of benzol, naphthenes, alcohol, etc.
3. The design of the combustion head.

The author regards "dopes" as suitable for "stunt" fuels only. In connection with combustion head designs, the author describes experiments on a side by side valve engine in the head of which is located a row of thin quartz windows; by phasing mechanism, the flame travel across the head can be followed, pressure records are taken by means of a Farnboro' indicator. When pinking is absent the flame travels regularly across the head; when pinking develops simultaneously at all the windows, a flash is observed which develops after the normal flame has completely traversed the cylinder head. The effect of various heads on this engine was exhaustively examined; by reducing the rate of pressure rise, by means of modifications to the head, a trifle was lost in efficiency, but a large gain was obtained owing to a higher compression ratio being possible without pinking developing. The author mentions a recent engine operating with pinking at a maximum developed pressure of 1,100 lbs./sq. in. With regard to valve position the author states that provided the stroke is not abnormally short, the side by side valve engine will, at the same compression ratio, give exactly the same performance as the overhead valve type; owing to the more central position of the sparking plug in the side by side type, it will stand a higher compression ratio without pinking than the OHV type.

With regard to supercharging, the limit of power is reached in any engine when the speed of revolution becomes so high as to be mechanically destructive and when the flow of waste heat becomes greater than that with which we can cope. The author considers supercharging to be a passing phase made possible for the moment because in the race for improvement the thermodynamic side has moved more rapidly than the mechanical. W. N. H.

342. Gas Flow Through High Pressure Lines. E. L. Rawlins. *Oil and Gas J.*, 1927, **25** (48), 40, 154–155.

The deciding factors influencing the flow of gas through lines are: (1) quantity; (2) absolute inlet pressure; (3) absolute outlet pressure; (4) diameter of pipe; (5) length of line; (6) sp. gr. of gas; (7) factor for pressure and temperature correction; and (8) calibrated constant for variation correction due to conditions.

Weymouth's formula is derived from Unwin's formula, which is

$$U = \sqrt{\frac{gCTM}{f_1}\,\frac{(P_1^2 - P_2^2)}{P_1^2}}$$

where U = initial velocity, feet per sec.
g = acceleration due to gravity.
C = thermodynamic constant of the flowing gas $= \frac{PV}{T}$.
T = absolute temperature of gas.
M = hydraulic mean radius of pipe = O/4.
P = absolute initial pressure of gas = lbs./D″.
P = absolute final pressure of gas = lbs./D″.
f = coefficient of friction.
l = length of line, feet.

Experiments indicate that f is a variable, the curve being represented approximately by the equation $f = \frac{0{\cdot}008}{\sqrt[3]{d}}$

The final form of Weymouth's formula is :—

$$Q = \frac{37[(P_1^2 - P_2^2)d^{5\frac{1}{3}}]^{\frac{1}{2}}}{L}$$

where the standard condition of gas measurement is 60° F. and 14·65 lbs. absolute pressure, and a flowing temperature of 40° F.

If a line is composed of several lengths of varying diameters, each length must be transferred into an equivalent length of one diameter by the formula :

$$L'_n = L_n\left(\frac{d'_n}{d_n}\right)^{5\frac{1}{3}}$$

These lengths added together give the value of L in the flow formula.

"Storage capacity" is the difference between unpacked conditions, when the gas is flowing at the average daily rate, and packed conditions, when intake pressure is at its maximum and flow a mean between minimum and average.

Various formulæ have been developed and used for pipe-line flow, as follows :

General formula :

$$Q = C\frac{\sqrt{(P_1^2 - P_2^2)D^5}}{LG}$$

which gives the relation between the quantity of gas, Q, and the various influencing factors.

Cox formula :

$$Q = 3000\frac{\sqrt{(P_1^2 - P_2^2)D^5}}{L}G(65)$$

Rix formula :

$$Q = 2680\frac{\sqrt{(P_1^2 - P_2^2)D^5}}{LG}$$

Towl formula :

$$Q = 50\frac{\sqrt{(P_1^2 - P_2^2)D^5}}{L}$$

Pittsburgh formula :

$$Q = 3450\frac{\sqrt{(P_1^2 - P_2^2)D^5}}{L}$$

Transferred to general formula, the constants for these four are 2,419, 2,680, 2,782 and 2,672 respectively, a variation of over 10 per cent.

Oliphant's formula is :

$$Q = 42a\frac{\sqrt{P_1 - P_2}}{L(\text{miles})}G(0.6)$$

$$A = \sqrt{D^2 + \frac{D^2}{30}T(60°)}$$

Spitzglas :

$$Q = 64.3\left(\frac{PAd^5}{8L(1 + \frac{3.6}{d} + 0.03d)}\right)^{\frac{1}{2}}$$

where Q = standard cu. ft. per hour.
A = mean pressure.
d = internal diameter.
S = density.
L = length in miles.

The object of the studying of gas flow in pipe-lines is to obtain information for design of lines and capacity effects under varying conditions. The results desired are: (1) a dependable formula for calculating flow; (2) the effect of frictional resistance in pipe-line flow; (3) the relation between pressure drop per unit length of line and quantity flowing and other flow characteristics; (4) results of a pressure variation study on representative lines tested; (5) relation between total resistance to flow and diameter of pipe; (6) maximum flow variations due to conditions of pipe interior surface; (7) effects of chemical composition of gas; (8) effect of compressibility of gas; (9) measurements over a long period to get seasonable changes; (10) capacity or build-up effect in pipe-lines and volume and pressure changes due to fluctuating demand; and (11) data from experimental work so that a number of lines and conditions can be selected to make the results generally applicable.

G. S.

343. High Revolution Oil Engines. *Gas and Oil Power*, April 7, 1927. 146.

A paper read by Mr. P. A. Holliday, of Messrs. Bellis and Morcom, Ltd., before a meeting of the Diesel Engine Users' Association, makes out a strong case for high revolution oil engines. He quotes as an example the heavy oil engine plant in the power stations of the Southend-on-Sea Corporation, which consists of ex-submarine engines converted for land use. This plant has given satisfactory working results.

It is pointed out that by increasing the speed of an engine its weight may be reduced and also the floor space occupied, thus giving reduced cost of engine and of land and buildings required by land engines, while for marine use extra cargo may be carried.

The main particulars of a new 600 b.h.p. engine produced by Messrs. Bellis and Morcom, Ltd. are given. The engine has six cylinders and works on the four cycle principle at 350 r.p.m., which, with cylinders of 15½ inch bore by 17 inch stroke, gives a mean piston speed of 995 ft. per minute. This may be compared with an engine which has been produced by the same firm for some years and which develops 80 b.h.p. per cylinder from cylinders 15½ inches bore at 210 r.p.m. The weight of the new engine has been reduced to under 150 lbs. per b.h.p., including all accessories, which is about half the previous figure. This weight could be still further reduced, if specially desired, by the use of cast steel or aluminium in place of cast iron for certain parts. Test bed results have given full load fuel consumption as ·61 lb. per kw. hour, and it is thought that this figure may be improved upon in view of the behaviour of the engine now in service.

Actual up-to-date figures for the cost of an 800 kw. generating station are £23 per kw., installed. This figure includes everything necessary from fuel bunker tank to switchboard.

E. R. B. S.

344. The Intercrystalline Corrosion of Metals. Rawdon. *J.I.E.C.*, May, 1927.

Intercrystalline corrosion occurs in metals from soft ones such as tin and lead, to harder ones such as nickel and iron. In some alloys it is due merely to some characteristic peculiar to the alloy.

The corrosion of a metal while under tensile stress is a common cause of intercrystalline brittleness, although different corrosive solutions are required to accomplish the desired results with different metals. No generalisation as to the essential characteristics of the corrosive solution necessary for causing intercrystalline attack of stressed metals appears to be warranted from the evidence so far obtainable. As a preventative, the stress on the metal should

be reduced to well below the yield point, coating with some protective coating or possibly by suitable heat treatment. A. R. S.

345. Embrittlement of Boiler Plate. Pau and Straub. *J.I.E.C.*, May, 1927.

By embrittlement of boiler plate is meant the condition which is indicated by intercrystalline cracking in the rivetted areas.

This fracture resembles that of a brittle metal and usually occurs in the area round rivetted joints. Various theories have been put forward to explain this, such as too much cold working or fatigue, but these have been shown to be incorrect as such fractures are invariably transcrystalline. The theory is advanced that it is due to the decomposition of sodium carbonate to sodium hydroxide at high temps. At working boiler temperature and pressures caustic soda is known to interact with iron with liberation of hydrogen and great reduction in ductility.

As proof of this experiments conducted with perfectly ductile boiler plate which would normally carry a load of 37,000 lb. per square inch at 300°C. in contact with air and water for many years will fail by fracture in as short a time as 12 hours when brought into contact with a solution of sodium hydroxide at this temperature. A. R. S.

346. Use of Lime in Water Softening and Water Purification. Hoover. *J.I.E.C.*, May, 1927.

The addition of lime to water not only softens it but when added in sufficient quantity to produce excess lime kills intestinal and pathogenic bacteria, rendering the water safe bacterially. Lime softening also increases the efficiency of sedimentation because better coagulation is effected. Besides being low in turbidity, lime-softened water will be low in colour and organic matter, these having been absorbed by the gelatinous precipitate. Gases such as carbon dioxide and sulphuretted hydrogen are neutralised.

Two limitations have held back the use of lime for softening, namely because: (1) The treated water was supersaturated with normal carbonates of calcium and magnesium, which became deposited in pipes and meters, and (2) Limited reduction in hardness could only be obtained due to the formation of soluble complex basic carbonate of magnesium.

These limitations may be overcome by: (1) Treating the water at elevated temperature, say 60°F.; (2) Recarbonisation of the treated water by passing in carbon dioxide till the final water is faintly pink on addition of phenolphthalein; (3) Adding a slight excess of lime and neutralising this excess with soda ash; (4) Split treatment, consisting in treating only part of the water and blending this with untreated water; (5) Addition of aluminium compounds to convert the soluble magnesium salts to insoluble aluminates. A. R. S.

347. Induction Currents. L. Mantell. *Automobile Engineer*, May, 1927.

The problem of the correct distribution of the charge to a six-cylinder engine is considered. With a four-cylinder engine and an ordinary T shaped manifold a firing order of 1, 2, 4, 3 or 1, 3, 4, 2 gives a current reversal in the horizontal part of the pipe once per revolution; the amplitude of the reversal is approximately half the gross displacement of the engine. With a six-cylinder engine with an ordinary T shaped manifold an order of firing of 1, 4, 2, 6, 3, 5 or 1, 5, 3, 6, 2, 4 gives a current reversal of three per revolution, the amplitude of which is one-sixth the gross displacement of the engine. Assuming that the unvapourised portion of the fuel largely impinges on the wall facing the vertical portion of the T then the high frequencies reversal of small amplitude will

allow a far greater quantity of stagnant liquid fuel to collect at this point than the low frequency large amplitude conditions obtaining in the four-cylinder manifold.

If two carburettors are used then an order of firing 1, 5, 3, 6, 2, 4 is shown to give smaller column inertia shock between inspirations 1 and 3 than with the order of firing 1, 4, 2, 6, 3, 5; the former order will therefore tend to reduce fuel deposition. Best distribution results with a single carburettor are obtained if a local hot spot is situated at the impingeing point of the T, the extensions of the pipe are cooled as much as possible to keep up volumetric efficiency. If the hot spot is correctly located little trouble is experienced with radiused corners for the individual cylinder ports. A mean velocity of 200 ft. per second is recommended as a safe average vapour speed for experimental work; the carburettor branch pipe should be approximately 10 per cent. greater in area than the horizontal part. W. N. H.

348. The Brunler Flame and its Industrial Applications. O. Brunler. *The Industrial Chemist*, May, 1927.

The Brunler flame burns when submerged in water and has been adapted for use in industrial operations. Essentially the apparatus consists of a water-cooled burner which is fed with fuel under pressure and the theoretical quantity of compressed air.

In using the Brunler flame for steam-raising it is burnt in a boiler below the surface of the water; the steam and gases pass off and may be superheated by a second burner; dissolved impurities in the water settle out and form a sludge on the bottom of the boiler which can be drawn off from time to time.

As the temperature of the flame is about 1800°C. complete combustion takes place, all carbon monoxide being burnt. The steam-gas mixture consists of 50 per cent. steam and 50 per cent. carbon dioxide and nitrogen, and gives the highest efficiency when highly superheated.

The advantages of the flame for steam raising over the usual boiler are economy of fuel in that complete combustion takes place and there is no scaling of boiler plates.

The flame has been successfully used for the concentration of waste sulphite liquor and sewage liquors. In both cases the residues make quite good material for use in producer gas plants for supplying gas fuel for the burner. Zinc chloride solutions have been concentrated although slight decomposition seemed to take place as the boiler plates became coated with a deposit of zinc.

The manufacture of nitric acid or its calcium salt can be economically carried out by means of the flame. The air used for this purpose has an oxygen content of 40—50 per cent. This mixture is obtained by forcing air up a pipe down which water is allowed to flow; the dissolved air is removed by means of a vacuum pump and again dissolved in water as before. Owing to the greater solubility of oxygen in water the oxygen content of the gas-mixture gradually rises until at the end of the fourth cycle it is between 40 and 50 per cent.

It is found that contrary to the usual equilibrium conditions the higher the temperature of the flame the greater the yield of oxides of nitrogen. By submerging the burner in lime water a calcium nitrate solution is obtained; this is concentrated by means of another burner in a separate vessel.

The steam-gas mixture from the acid plant is used in a turbine for generating all the power needed to run the whole plant. It is found that no corrosion of the turbine blades takes place if the temperature is kept above 84°C. The exhaust gases from the turbine are led through an oxidising and absorption tower and the solution is then neutralised with lime.

The Brunler flame can also be used for melting minerals and in the preparation of alloys. K. B, R.

See also Abstract No. 296, and also those under the headings of Refinery Plant and Oilfield Technology.

Anti-detonation.

349. Autohydration and Deoxidising Actions. XXII.: Notes on the Method of Action of Anti-Knocks. C. Moureu. *Chimie et Industrie*, April, 1927.

A connection is traced between the reactions taking place in a petrol-engine cylinder and autohydrations taking place slowly at ordinary temperatures and pressures; thus ethylene, carbon monoxide and sulphur trioxide inhibit the combustion of hydrogen in the presence of spongy platinum, and the same substances also inhibit gaseous explosions; again, aniline, diphenylamine and triphenylamine inhibit oxidation at ordinary temperatures of benzaldehyde; these same substances also act as anti-knocks, and in both the above actions the order of relative efficiency is the same.

Various theories of the action of anti-knocks are reviewed and dismissed as unsatisfactory. In developing his theory, the author postulates an "active state" of certain molecules of the hydrocarbon in the explosive mixture. He then continues: "Using the fruitful idea of activity we see that only the active molecules of A (the hydrocarbon) and O_2 unite to form a peroxide AO_2. It is admitted that this is produced by the active molecules of A and O_2 with a small evolution of energy, while it is produced from ordinary molecules of A and O_2 with absorption of energy on the whole. Granting this, the following is the mechanism of the deoxidising catalysis: AO_2 oxidises the deoxidiser B to form BO and AO. The two peroxides AO and BO being antagonistic destroy each other (in a similar way to those known when two antagonistic peroxides react) with the regeneration of three molecules A, B and O_2. The energy expended in these three reactions above is borrowed from the energy of activation of A and of O_2, which makes the reaction one of catalytic deoxidation and of deactivation of A and O_2."

Further information giving the results of the practical application of this theory will be given. W. N. H.

350. Measurement of Anti-Knock Value of Gasolines. Round table Discussion at seventh annual meeting of A.P.I.

Dr. Graham Edgar (Ethyl Gas Corporation) described the modified Delco-light generator set used in connection with the bouncing pin for the estimation of knocking intensity; he emphasised the comparative nature of all such estimations; the two standard hydrocarbons used as a standard of knock were mentioned, normal heptane and tri-methyl isobutyl methane, the equal volatility of these two hydrocarbons is especially in their favour.

Dr. G. G. Brown (Michigan University) discussed the contradictory evidence of bomb investigations regarding rate of rise of pressure as influenced by initial temperature of the mixture; two effects are present in such experiments—one decreasing the magnitude of the pressure rise with increase of initial temperature, the other increasing the rate of pressure rise with increase of initial temperature. Detonation in bomb experiments is considered to be a different phenomenon from engine knock. Although in bomb experiments benzol showed about the same tendency to detonate as normal octane, yet when the aromatic or paraffin series are considered separately it is found

that the tendency of the separate members to detonate was similar to the knocking tendency in an engine. The inter-relation of maximum rate of pressure rise on explosion, auto-ignition temperature and highest useful compression ratio is illustrated for various substances.

The speaker found the bouncing pin a delicate apparatus to maintain in working order and the results obtained not in agreement with either audibility tests or road tests. It was considered that the pin was affected largely by the rate of rise of pressure and not by the detonation itself. Tests were outlined having for their object the power output obtainable on an engine (compression ratio 7·2:1) using various fuels, all conditions are maintained constant except the position of the ignition, which is varied until maximum power output is obtained.

Dr. H. C. Dickinson (Bureau of Standards) said that the majority of his work had been carried out on a single cylinder of the Liberty aeroplane engine developing 40 h.p. In his tests a compression ratio of 6·5:1 is used, speed is maintained constant at 1,500 r.p.m., the fuel to be tested is fed at a normal rate and the throttle is opened until a knock is just audible; in all, five different rates of feed are used successively for each fuel. As a result a difference in mean effective pressure is obtained representing the difference between the anti-knock tendencies of the two fuels. A brief outline of bomb experiments was given which have also been used as a test for the knocking tendencies of a fuel; a diaphragm located at the end of the bomb has a light steel ball resting on it; when an explosion occurs the height to which the ball is jerked gives a measure of the knocking value of the fuel.

Dr. R. E. Wilson (Standard Oil Co. of Indiana) mentioned several cases where different engines and different apparatus did not give identical results for the knock-rating of various fuels; these were in part due to different mixture strengths used. The use of a single cylinder engine for knocking tests was strongly recommended owing to the absence of distribution effects. The air-cooled Delco-light engine was, in the speaker's opinion, not nearly of sufficiently rugged construction nor was the control sufficiently fine to be used as a test engine for knocking.

The variable spark method for comparing two fuels was deprecated as involving running the engine under abnormal conditions, i.e., all other conditions including full throttle are maintained constant, the spark is then advanced until a knock is heard. The variable compression engine was considered to be too expensive to be universally adopted. The variable throttle opening was adopted in the speaker's laboratory as this in effect made the engine a variable-compression one. Mixture ratio was adjusted at all throttle positions to give an 11:1 mixture, the incipient knock-point is determined audibly, as a loss-in-power method involved running the engine under unduly severe conditions. Details of the test were given, results are expressed as so many c.c. of lead tetraethyl per gallon required by the standard petrol in order that its knocking performance shall equal that of the sample.

Mr. T. A. Boyd (General Motors Research Laboratories) said that he continued to use the bouncing-pin method; a variable compression engine was used. In order to determine the amount of tetraethyl lead required by a petrol in order to equal the knock characteristics of the standard fuel a rough test is first made using a filament lamp in the circuit as a guide; determinations are then made of the number of c.c. of electrolytic gas generated with slightly too little lead tetraethyl and then again with slightly too much of the compound to obtain an exact match with the standard, the accurate quantity required is obtained by interpolation.

Mr. F. A. Howard (Standard Oil Co. of New Jersey) reported successful use of the Delco-light engine as a knock-testing engine, this being standardised

in all the company's refineries. Very good agreement was obtained between the tests so obtained and road tests.

Dr. L. W. Parsons (Tide Water Oil Co.) reported a similar experience to that of Mr. F. A. Howard; he also mentioned discrepancies between engine tests and knock-rating of fuels by means of chemical analysis.

Mr. A. L. Clayden (Sun Oil Co.) used the bouncing-pin outfit on a water-cooled engine; the mixture ratio of the heavily knocking standard fuel is adjusted until ·5 c.c. of electrolytic gas are generated in 100 secs., the sample of fuel to be tested is then fed to the engine and the time required for the generation of the same volume of gas is observed; this gives a measure of the knock characteristics of the sample. Good agreement with road tests was claimed. Inexplicable temporary defects of the bouncing-pin outfit were claimed.

Mr. Herschel Smith (Gulf Refining Co.) said that a modified water-cooled Delco-light single-cylinder engine was used as the test engine, using the sturdy base, connecting-rod and bearings of a large model with the small cylinder and head of a smaller type. In the test the throttle is progressively opened until a slight falling off in power is observed, due to knocking. A heavy-knocking and a non-knocking standard fuel are used, and all commercial gasolines are found to fall between these two limits. The speaker mentioned successful use of the bouncing pin, in particular the use of an integrating ammeter in place of the usual electrolytic cell.

Dr. Faragher (Universal Oil Products Co.) considered that Dr. Wilson's failure to correlate engine tests with road tests probably was due to faulty carburettor adjustment in the latter tests. Successful use was mentioned of a water-cooled Delco-light engine and a modified bouncing pin in which the cell was replaced by a heavy pointer which was deflected by the throw of the pin. Knock-rating of fuels in terms of benzol was advocated.

Dr. J. C. Morrell (Universal Oil Products Co.) stated that the analytical method of estimating the anti-knock value of a fuel is suited primarily for the determination of this value for motor fuels where it has been found to apply.

W. N. H.

Cracking.

351. Investigations of the Cracking Process. A. Sachanen and M. Tilitscheyew. *Petr. Zeit.*, 1927, 521.

The purpose of this work was to investigate the time temperature and pressure conditions of cracking in the liquid phase. The apparatus used for the experimental work consisted of a still of 2½ litres capacity, a dephlegmator, cooler, receiver, and gas meter with the usual thermometers, pressure gauge and relief valves, necessary for controlling the conditions of the experiments. After operating the apparatus the cracked oil was distilled into three fractions: (1) benzine up to 200° C.; (2) kerosine from 200° to 300° C.; (3) residue above 300° C., and the resins, asphalt and coke were determined by the usual methods. As heating and cooling of the apparatus took a certain time, a correction was applied when, for instance, the experiment was carried out at 425° for 30 mins., the time of heating from 375 to 425° occupied 15 minutes and the time of cooling from 425° to 575° took 8 minutes. The mean temperature is 400° and the total time of heating and cooling 23 mins. The velocity of cracking is 6 times as great at 425° as it is at 400°, therefore the time of cracking will be 23 : 6, i.e., about 4 mins. to be added to the principal 30 mins. at 425°. The total time of cracking at 425 = 34 mins. The time required to heat to 375° is neglected as the velocity of cracking up to this temperature is not measurable.

A paraffin oil obtained from Grosny petroleum by distillation was subjected to cracking. The constants of this oil were as follows :—

Specific gravity at 15° C. = ·883, E_{20} = 1·96, acid resin value 5 per cent., wax 10·5 per cent., I.B.P. = 180° C., fraction to 200 = ·3 per cent., to 300° = 3·3 per cent.

Cracking experiments were conducted under different conditions and the following conclusions arrived at. Lighter and heavier products—benzine and kerosine—are formed in nearly equal quantities. Under the same temperatures and pressure conditions, the yield of cracked spirit or the combined yield of benzine and kerosine rises with the time. The maximum yield of cracked spirit for the paraffin oil under investigation amounted to 36 to 39 per cent., and the benzine and kerosine together about 65 per cent., but a higher yield of these products may be obtained by recycling as in various modern cracking processes. The influence of pressure diminishes the yield of benzine and kerosine probably due to condensation. This is avoided in tube cracking systems where the temperature is high but time of reaction short. The value of pressure exists mostly in maintaining the liquid phase. The time which is requisite for producing the maximum yield of cracked products (65 per cent.) depends substantially on the temperature. From these investigations the following time-temperature values were obtained :—

Cracking Temperature.	Maximum Yield.
375°	45 hours.
400	9 „
425	1½ „
450	12 „
475	2 „ (calc.).
500	20 „ („).

As these figures show, the velocity of cracking increases 5 to 6 times for each 25° rise like other chemical reactions which double the rate for every 10°. Condensation products are formed at the same time as decomposition products of cracking and the residue shows a higher acid resin value and very high specific gravity (1·04), although the higher fractions of the original oil have only a gravity of from ·897 to ·906. The specific gravity of the cracked residue increases with the time of reaction, and a longer time causes the formation of asphaltenes and coke. By increased time, the acid resin value is reduced, but at the same time the asphalt and coke are increased greatly. Finally the asphaltenes disappear and coke only remains.

The velocity of cracking depends not only on time and temperature, but also on the character of the original oil. Spindle oil, S.G. ·904, and machine oil, S.G. = ·930, were also cracked at 450° C. at 10 atmospheric pressure for 12 mins. The kinetics of this experiment are the same as for the paraffin oil under investigation, 28–31 per cent. of benzine and about 25 per cent. of kerosine were produced, and the formation of asphalt and coke increased with the increase of specific gravity of the original oil. The cracking of solar oil, S.G. = ·883, proceeds at a rate 1½ to 2 times slower than the paraffin oil and kerosine, S.G. ·821, under the same conditions only 4·9 per cent. of benzine. In the cracking of kerosine and light solar oil no coke formation was observed. These results lead to the conclusion that the lighter and heavier cracked products are formed by different constituents of the original oil. To prove this theory, paraffin wax (52/54° M/P) and a paraffin oil purified by treatment with 80° of fuming sulphuric acid were cracked and no coke was obtained, besides the specific gravity of the residue remained unaltered, irrespective of the time of reaction. It is therefore inferred that the paraffin hydrocarbons do not yield condensation products. Likewise, in the cracking of the refined

paraffin oil, condensation phenomena were slight. As fuming acid removes completely the aromatic hydrocarbons, it is apparent that polymerised substances and coke are produced at the expense of the aromatic compounds. Heavy petroleum oils with a high aromatic content show by cracking a high coke yield. The chemical composition of the cracked spirit was determined by the method of Egloff. This method gives approximately the content of paraffin, naphthene, olefin and aromatic compounds in cracked spirit. Analysis shows the influence that pressure has. Increase of pressure diminishes the amount of olefins. Naphthenes are small in amount (4 to 7 per cent.), and it is noticeable that cracked spirit from oil rich in paraffins has a low content of naphthenes. There is a complete absence of naphthenes in spirit obtained by cracking paraffin wax.

These experiments lead to the conclusion that, contrary to the opinion of many investigators, ring closing of the olefins and conversion into naphthenes plays no part in cracking. R. P.

352. Cracking of Brown Coal Generator Tars. *Petr. Times*, 1927, 17, 1082.

This constitutes a brief resumé of recent work by Varga and Erdély. Five different brown coal generator tars obtained during the gasification of Hungarian brown coals were subjected to pressure distillation in a 2·5 litre autoclave fitted with dephlegmator, condenser, receiver and gas-scrubbing attachment. Texas, Russian and Roumanian gas oils were similarly treated for purposes of comparison. A refined generator tar-oil (Sp. G. 0·920 : I.B.P. 218° C. : 99 per cent. distilling below 350° C.) was distilled in three experiments under the following conditions : pressure in atmospheres 10, 20, 30 : average temperature 400°, 404°, 414° C. ; time in hours 7·1, 4·0, 4·5. The yields of products were as follows : benzine (E.P. 200° C.) 41·1, 36·8, 37·0 per cent. ; gas 95·5, 132, 134·5 litres per litre of tar ; residual oil 21·2, 18·1, 5·7 per cent. ; coke 26·6, 27·4, 27·4 per cent. A Roumanian gas oil treated under similar conditions gave 51·4, 45·4 and 46·2 per cent. of benzine for the respective experiments, the gas, residual oil and coke being generally greater in amount from the gas oil than from the tar. The generator-tar cracked benzines, after refining, varied in specific gravity from 0·810 to 0·733 and in percentages volatile below 100° C. from 11·3 to 18·7 per cent. H. G. S.

353. Cracking Low-Temperature Coal Tar. G. Egloff and J. C. Morrell. *Oil and Gas Journal*, Dec. 16, 1926, 156.

A West Virginia coal subjected to low-temperature carbonisation gave 25 (U.S.A.) gallons per ton of coal. The dry tar (Sp. G. 1·074) distilled at an average temperature of 452° C. and a pressure of 100 pounds per square inch gave 30 per cent. of motor-fuel containing 25 per cent. of tar-acids. A second tar (Sp. G. 1·0794 : tar-acid content 27·5 per cent) derived from a Ohio-Indiana bituminous coal was similarly cracked at 100 pounds pressure and 427° C., giving 33·9 per cent. of spirit which contained 35 per cent. of tar acids, 42·9 per cent. of coke, 12·5 cu. ft. of gas per gallon of tar and 3·9 per cent. of water. The spirit possessed an anti-knock equivalent of over 50 per cent. benzol. The tar acids may be left in the spirit if desired.

Cracking of a neutral oil distillate from the West Virginia tar is also described. The neutral oil, obtained by removing the tar-acids from the fraction, and having specific gravity 0·948 was distilled at 454° C. and 200 pounds pressure per square inch. The yield of spirit was over 50 per cent., other products being coke (2 pounds per gallon) having a calorific value of 16,000 B.Th.U.'s per pound and gas (20 cu. ft. per gallon) with a calorific value of 1,300 B.Th.U.'s per cu. ft. The cracked spirit had a 50 per cent. benzol anti-knock equivalent. H. G. S.

354. The Cracking of Spindletop Crude Oil. G. Egloff and J. C. Morrell. *Petr. Times*, 1927, **17**, 773-4, 811-2.

In 1921, the first gusher well in the Spindletop field was brought in and in 1902, the peak year, the total Spindletop production was 17,700,000 barrels, falling steadily thereafter to 350,000 barrels in 1924. Oil was found at a lower level in 1925 and the production is now at the rate of 90,000 barrels per day. Drilling to a depth of 10,000 feet is being undertaken. It is estimated that 32,000,000 barrels of crude oil will be obtained from Splindletop during 1927. The crude has hitherto been used mainly for fuel purposes but the authors have found that under cracking conditions, it yields a cracked gasoline possessing a benzol equivalent of 45 per cent.

Cracking tests were made upon crudes derived from two deep sands opened up within the last year. The two oils were simultaneously topped and cracked, each under two conditions of operation, one designated as the "non-residuum" type producing cracked distillate and coke, the other giving a residuum oil, as well as cracked distillate and coke.

Oil A.—Specific gravity 0·919, distilled to non-residuum at 150 pounds pressure and 449°C., gave 50·1 per cent. of N.E.P. gasoline, 19·5 per cent. of gas oil, 27 pounds (per barrel) of coke and 608 cubic feet of gas (per barrel). The same oil, distilled at 150 pounds and 432°C. gave 46·1 per cent. gasoline, 35·7 per cent. residuum, 7·3 per cent. gas oil, 8 pounds coke and 334 cubic feet. of gas.

Oil B.—Specific gravity ·883, at 150 pounds and 454°C. gave 65·2 per cent. gasoline, 15·9 per cent. gas oil, 27 pounds coke and 438 cubic feet of gas; at 150 pounds pressure and 432°C. the yields were 52·9 per cent. gasoline, 27·6 per cent. residuum, 7·6 per cent gas oil, 4 pounds of coke and 264 cubic feet of gas. H. G. S.

355. (*A*) Apparatus for Condensing Oils; (*B*) Process of Converting Higher Boiling Petroleum Hydrocarbons into Lower Boiling Petroleum Hydrocarbons. C. B. Buerger. (*A*) U.S.P. 1,622,941 of 1927. Appl. July 18, 1924; (*B*) U.S.P. 1,623,025 of 1927. Appl., July 22, 1925.

This invention is particularly applicable to cracking processes which involve distillation of heavy oils in presence of aluminium chloride. The vapours, which may be contaminated with hydrogen, titanium, silicon and iron chlorides, are scrubbed and condensed with water. The mixture of aqueous solution of chlorides and condensed oil is then delivered below the surface of a column of water and the oil and water separated. H. G. S.

356. Treating Hydrocarbon Oils. W. L. Coultas, jr. U.S.P. 1,628,532 of 1927. Appl., July 12, 1920.

The treatment consists in vaporising oil under pressure, introducing free hydrogen whilst cracking the oil, distilling the product under pressure, returning the condensate for further treatment and filtering the cracked gasoline through, say, fuller's earth both before and after condensation. H. G. S.

357. Process and Apparatus for Converting Petroleum Hydrocarbons. R. Cross. U.S.P. 1,624,778 of 1927. Appl., Oct. 29, 1923.

The process consists in cracking heavy oils in preheating, heating and conversion stages, utilising the heat of the vapours and oil leaving the converter to preheat the incoming oil and the energy of the oil for operating a scraper to retard deposition of carbon in the converter. In the preferred form of apparatus, the oil to be cracked is pumped into a horizontal preheater whence it flows into a compartment of the horizontal converter. Thence it

passes, either by gravity or by means of pumping, through a heating coil into the second compartment of the converter. The vapours liberated at this stage return through a pipe connecting the vapour spaces of the two compartments of the converter, are made to traverse an extended path through the oil in the preheater and are then taken through a dephlegmator and condensers to a gas separator and storage. The unvaporised oil in the converter enters a pipe which is fitted with a spiral rotator or turbine arrangement fixedly attached to a scraper. The latter rotates, maintains the oil in a state of turbulence and removes deposited carbon from the walls of the converter. The exit pipe conveys the unconverted oil through the preheater and release valve to storage. H. G. S.

358. Process for the Conversion of Heavy or Complex Hydrocarbon Oils into Lighter Oils. J. F. Donnelly. E.P. 243,339 of 1925.

The process is designed to crack relatively heavy oils without reducing the heavier conversion products to hard carbon or coke and to avoid dissociation of the heavier constituents like lubricating oils and wax. The oil to be treated is heated to cracking temperature in a coil under sufficient pressure, *e.g.*, 70 atmospheres, to maintain it in the liquid phase. It is then delivered into an expansion chamber at a lower pressure to cause distillation to take place. The vapours are refluxed, a portion of the condensate uniting with the unvaporised oil in a chamber and the remainder being directed into another chamber where it is mixed with fresh stock. The mixture of condensate and residue is then forced into the oil stream at the moment it enters the expansion chamber, thus cooling the expanding cracked oil and preventing deposition of coke. H. G. S.

359. Process and Apparatus for Converting Oils. C. P. Dubbs. U.S.P. 1,628,236 of 1927. Oct. 8, 1921.

The salient object of the process is the percolation of heated gases through oil which is being distilled under pressure, so as to prevent deposition of carbon and to enable lower temperatures to be used in the heating circuit. Another object is the efficient utilisation of heat in the system. The cracking stock first flows through a dephlegmator in counter-current to cracked vapours and, together with the reflux, passes through coils heated in a furnace. It is then delivered into an expansion chamber fitted with vapour line and residue draw-off. The body of oil in the expansion chamber, which is heat-insulated, is maintained in a state of agitation by the entrance of the permanent gases produced in the process, the gases being raised in temperature by passage through coils heated by the flue gases. H. G. S.

360. Method for Treating Petroleum and other Hydrocarbons. C. P. Dubbs. U.S.P. 1,627,159 of 1927. Appl. July 16, 1923.

The process consists in cracking oils at successively increasing temperatures in a series of stills. The vapours from each still, after refluxing, are passed through the next cooler still in the series, the vapours leaving the last still being condensed. Further, the uncondensed gases are made to enter the hottest end of the series whilst the oil overflowing from one still passes forward into the next hotter still. H. G. S.

361. Apparatus for Treating Oils. G. Egloff and W. R. Howard. U.S.P. 1,627,164 of 1927. Appl. Feb. 5, 1927.

The apparatus consists essentially of cracking tubes, a horizontal, cylindrical expansion chamber, a dephlegmator and condenser. The oil, after passing through the cracking coils, is conducted through a pipe which extends

throughout the length of the expansion chamber into which it is then liberated. The carbon which is deposited at this stage falls into a vertical leg under the discharge end of the conduit, whilst the vapours pass away through the dephlegmator. The latter is positioned at the end of the expansion chamber remote from the carbon leg or pot. H. G. S.

362. Process for Cracking Hydrocarbon Oils. W. F. Fahager and W. A. Gruse. U.S.P. 1,629,908 of May 24, 1927. Appl. Jan. 15, 1921.

This invention relates to an improvement of overcoming the deposition of carbon in a cracking still, without the use of scrapers or agitators. The cracking operation is carried out in a still of the water tube type, wherein the circulation of oil is carried out by means of jets of gas. The form of apparatus described consists of a horizontal still, with two transverse drums situated beneath it. The latter are connected to the front and back ends of the still by large tubes, while the transverse tubes are connected to each other by a series of smaller tubes, which receive most of the furnace heat. The still is supplied with dephlegmator and a vapour pipe leading to a condenser. In the shorter of the "legs" a gas jet is placed, and on the air lift principle the oil is caused to circulate rapidly up this leg, into the still, down the other leg, and through the heating tubes back to the jet. There are no stuffing boxes or moving parts working at a high temperature, but effective circulation is obtained in this manner. By the rapid and continuous circulation of the oil, uniformity of heating is promoted and cracking is more uniform, resulting in an increased yield of gasoline with lower coke and gas losses. The gas used is produced in the process, and the operation is continuous, as the residuum is removed and fresh oil automatically supplied. R. P.

363. Treating Hydrocarbons. W. S. Hadaway. U.S.P. 1,628,143 of 1927. Appl. Sept. 15, 1923.

The invention is particularly applicable to the method of cracking in which the oil is brought to reaction temperature in a coil or similar heating means, and then discharged into an enlarged chamber. Its object is to maintain the heat necessary for cracking in the expansion chamber by diffusing the heated oil rapidly, and into all portions of the mass of oil in the chamber. This is accomplished by heating the stock in a coil to a temperature of from 25° to 100° F. above its cracking temperature and then causing it to enter the enlarged chamber through a hollow, rotating shaft which is fitted with a number of side tubes. The mass of oil is thereby maintained at a constant temperature throughout its bulk by the agitation due to stirring and spraying of the incoming oil. H. G. S.

364. Treating Hydrocarbon Oils. R. C. Holmes. U.S.P. 1,623,729 of 1927. Appl. Aug. 17, 1921.

Heavy oils such as asphaltic crudes, are heated to temperatures between 370° and 480° C. under such pressures (500 to 3000 pounds per square inch) that the oil is maintained completely in the liquid phase. The resulting product may either be used direct as a fuel oil of lowered viscosity, or it may be distilled. In the latter case, the oil enters a lagged or slightly heated still in which the pressure is super-atmospheric and preferably 25 per cent. lower than that in the cracking coils. The vapours disengaged are refluxed, the condensate returning to the still, the overhead being condensed under pressure and the mixture of residual oil and heavy condensate being withdrawn continuously from the still. H. G. S.

365. Process and Apparatus for Treating Hydrocarbons. W. R. Howard. U.S.P. 1,627,436 of 1927. Appl. March 3, 1927.

The cracking of oils by pressure distillation is carried out in such a way that the vapours evolved are caused to traverse a body of reflux condensate contained in a second heated still. The apparatus consists of a still within which is placed a smaller still. The oil to be cracked is pumped under pressure into the larger still, which may be supplied with a system of tubes to facilitate cracking. The vapours enter the top of the inner vessel and pass through the reflux which has accumulated there and which is heated by the immersion of the inner in the outer still. The vapours then traverse a reflux condenser and ultimately pass through a condenser to storage. Means are provided to withdraw continuously the heavy oil from the cracking still and the condensate from the inner still. The condensate may be taken to storage or may be subjected to cracking in the tubes and returned to the main body of oil.

H. G. S.

366. Condensation of Hydrocarbons. E. W. Isom and J. E. Bell. U.S.P. 1,623,790, 1927. Appl. Sept. 10, 1923.

This is a continuation of U.S.P. 1,575,269. The cooling and condensation of hot vapours and gases produced by cracking oil is effected by passage through a relatively large volume of pressure distillate. The latter is cooled by means of coils through which a cooling medium is caused to flow, whilst the described method of injection of vapours and gases into the pressure distillate causes the latter to be vigorously agitated. Means are provided to withdraw the distillate continuously.

H. G. S.

367. Still. H. M. Lasher. U.S.P. 1,622,452 of 1927. Appl. July 1, 1920.

A cracking still is supplied internally with a shelf upon which is placed a catalyser such as coal or a carboniferous material. The shelf is suspended within the still and means are provided whereby its position may be adjusted from without.

H. G. S.

368. Method of Treating Hydrocarbon Oil. H. M. Lasher. U.S.P. 1,622,453 of 1927. Appl. Nov. 16, 1920.

This method consists in heating oil to cracking temperature in a vessel, preferably in coils, spraying the hot oil on to a catalytic material, which is spread over a shelf contained in a separate lagged chamber and subjecting the vapours to reflux action whereby the condensate returns to the still and is recirculated through the coils. The catalyst which is placed above the surface of the oil in the still may consist of carbon in the form of coke or coal or a deposit of carbon on a matrix such as fire brick, calcium chloride or sodium chloride. The position of the catalyst in the manner described leaves a "quiet zone" in the bottom of the chamber and allows deposited carbon to settle by gravity.

H. G. S.

369. Process and Apparatus for Cracking Petroleum Oil. R. T. Pollock. U.S.P. 1,628,270 of 1927 (Appl., Oct. 6, 1926).

The salient feature of the process is that the cracking stock and reflux condensate, or the latter alone, are distilled at atmospheric pressure or under a lower pressure than that at which the main apparatus is operated, in order to prevent oil which is sufficiently light from being returned to the cracking system. The apparatus comprises cracking tubes, vapour chamber, dephlegmator, condensers, etc., together with a still which is heated by means of flue gases. The raw stock is fed into the top of the dephlegmator and

falls, together with the reflux, into the still where the light constituents are removed by distillation. The topped crude stock and reflux are then pumped through the cracking coils. H. G. S.

370. Tube Oil Heater Control. F. M. Poole. U.S.P. 1,615,482, of 1927 (Appl., June 21, 1926).

The patent describes an apparatus in which oil is cracked by passage through tubes, some of which are heated by contact with gases of combustion and the remainder by radiant heat, the degree of cracking is controlled by automatically regulating the supply of air and fluid fuel to the burners. The control is effected by interposing two thermo couples at selected points in the path of oil and utilising the sum total of the E. M. F.'s of the couples to operate a motor geared to the air and fuel inlet valves. H. G. S.

371. Oil Heater and Method of Operating Same. J. Primrose. U.S.P. 1,626,874 of May 3, 1927 (Appl., May 11, 1925).

In this patent the principles of the Foster tube heating system are applied to obtain effective and efficient heating in a tubular cracking plant, with the minimum risk of overheating.

The plant consists of a furnace divided internally by a bridge wall into a combustion chamber and a heating chamber. The heating system consists of a horizontal row of tubes placed close to the roof of the furnace. These tubes are placed in cast-iron blocks, which absorb the radiant heat of the furnace and at the same time protect the tubes. In the heating chamber, three banks of tubes are situated, and extend through supporting plates on each side of the chamber. They are encased in corrugated iron sections, which increase the heat-absorbing surface. The various heating elements are connected, so that the incoming oil through the two lower banks of tubing, counter current to the flow of hot furnace gases. The oil passes thence through the tubes situated in the roof of the furnace, and finally through the upper bank of tubes in the heating chamber. Here the flow of oil is parallel to the flow of furnace gases, making it possible to subject the oil to prolonged heat treatment, whereby sufficient time is allowed for the cracking reactions to take place. The parallel flow of heating gases and oil in this portion of the plant has the special advantage that the temperature difference between oil and gas gradually diminishes. The corrugated sections encasing the tubes may be varied in design in order to have the proper amount of heating surface. R. P.

372. Process for Producing Gasoline. H. B. Setzler. U.S.P. 1,629,810 of May 24, 1927 (Appl., June 9, 1916).

The object of this invention is to produce the maximum yield of gasoline with a minimum of coke and gas, by the pressure distillation of gas oil. The feature of the invention is a cylindrical still equipped with a cleaning device, which consists of a double helicoidal scraper attached to a shaft. The shaft revolves in stuffing boxes cooled by water. It is claimed that the scrapers maintain the carbon in an amorphous condition, that they serve to distribute the heat throughout the still, and in addition have a catalytic action on the oil. R. P.

373. Pressure Still. A. J. Sloan. U.S.P. 1,619,440 of Mar. 1, 1927.

This patent covers an improved pressure still for cracking hydrocarbons and an improved automatic relief valve for use with the same.

The improvement in still construction consists of adding a bye-pass around the hand-controlled valve connecting the high pressure and the low pressure

sides of the plant, this bye-pass containing an automatic valve arranged to open at a pressure slightly above the normal working pressure but below that which would lift the main safety valve.

In case of abnormal pressure being developed in the still this would be relieved by the automatic valve and the oil and vapours discharged into the low pressure side of the plant instead of passing to waste through the main safety valve.

All moving parts of the patented automatic relief valve are contained within a single casting and thus leakage to the atmosphere is entirely eliminated. In detail the main casting consists of a horizontal tube the ends of which are turned one upwards and the other downwards and flanged for pipe connections. The upward leg contains a removable bush near its mouth forming on its lower edge a seating for the valve which lies vertically below. The connection to the high pressure side of the plant is made through a pipe bolted to the flange above the valve seating. Immediately below the valve seating is cast and machined a vertical cylinder in the wall of the casting, its open end being uppermost. The valve itself, which is of the mushroom type, has its head and stem machined in one piece with a small piston working in the cylinder just described. A small passage is machined through the valve stem putting the cylinder in communication with the high pressure so that the load to be supported is that caused by the pressure acting on the difference in area between the valve and its piston. The piston is made only slightly smaller than the valve head so that the unbalanced load is small. This load is carried by a horizontal lever which lies along the horizontal portion of the casting and engages with a projection on the valve stem. The lever is pivoted on a pin which is inserted through a screwed hole in one side of the casting near the valve and carries at the opposite end from the valve a weight which hangs down the vertical exit from the casting. The connecting pipe from the low pressure side of the flange is bolted to this vertical exit so that all the mechanism is contained in a chamber subjected only to a moderate pressure.

It is claimed that the valve is rapid in opening when any predetermined pressure is reached and, owing to the passage through the valve stem being small enough to make pressure changes in the balancing cylinder relatively slow, that it is rapid in closing after a small pressure drop.

To avoid chattering of the valve a supplementary spring load may be applied to the lever if found desirable and this may be varied by a screw projecting through the casting. E. R. B. S.

274. Treatment of Oils. W. O. Snelling. U.S.P. 1,624,848 of 1927 (Appl. Oct. 17, 1922).

The basis of the invention is the heating of heavy petroleum distillates and residues to elevated temperatures and under high pressure until equilibrium is attained. Thereafter, one of the products—gasoline—kerosine or synthetic crude—is slowly removed and fresh oil added without substantially affecting the equilibrium. The reaction vessel, which may be of tubular form when synthetic crude is withdrawn or in the form of a still with a cooled column when fractionation is desired, is preferably maintained about 3/11ths full. A catalyst such as graphite or fine nickel may be added to the oil to reduce the temperature and pressure at which equilibrium obtains. Further, the amount of permanent gas withdrawn from the system is sufficient only to maintain the desired pressure. The gasoline obtained is saturated and requires but little refining. H. G. S.

375. Cracking Liquid Hydrocarbons. H. O. Swoboda and E. M. Richards. U.S.P. 1,616,515 of 1927 (Appl., July 6, 1922).

The process described is designed to secure accurate temperature control and efficient heat interchange and to prevent deposition of carbon in the system by mixing steam with the oil to be cracked. A cracking tube, divided into preheating, converting, catalyser and condensing sections, is fitted with a concentric tube, except on the catalyser portion. The latter, which may contain any of the ordinary catalytic materials such as molydenum or vanadium, is electrically heated. The oil to be cracked, together with steam under pressure, is passed through the inner tube in counter current to a heat-exchange liquid, e.g., water, which flows through the outer tube. The temperatures of the various parts of the system are controlled by a series of thermo couples, which automatically regulate the heat applied to the catalyser and to the heat-exchange condensing fluid. H. G. S.

376. Apparatus for Cracking and Distilling Hydrocarbon Oils. S. L. Tingley. U.S.P. 1,627,937 of 1927 (Appl., Oct. 12, 1923).

The apparatus described may be used either for distilling oils or for cracking to produce either low-boiling hydrocarbons or oxyhydrocarbon gas. It consists of concentric inner and outer coils arranged in a cylindrical vertical furnace, the oil to be cracked being made to flow through the inner coil, and water in the outer, both in an upward direction. The tube containing oil is thus protected from direct heat of the furnace and deposition of carbon is reduced. The oil and superheated steam enter the bottom end of a mixing chamber, placed in the upper portion of the furnace and by the action of suitable baffles, are thoroughly intermingled. Tarry matter deposited in the mixer is withdrawn, the mixture of oil vapours and steam next passing into a fixation chamber which is also situated in the furnace but below the mixer. At this stage, the interacting vapours are made to take a series of upward and downward paths in concentric tubes of slowly increasing cross section whereby they are heated to a high temperature. The product which may be either gasoline and/or gas of high calorific value, is withdrawn and cooled or condensed. Means are provided whereby the flow of oil may be periodically interrupted and superheated steam blown downwardly through the inner coil to remove carbon. H. G. S.

377. Oil Distillation and Cracking. S. L. Tingley. U.S.P. 1,627,938 of 1927 (Appl., Dec. 28, 1923).

This invention is an improvement on U.S.P. 1,627,937 (see preceding abstract). In order to facilitate decomposition of the oil and steam before they enter the fixation chamber, they may be subjected, individually or combined, to the action of a radio-active substance, such as uranium oxide, or to violet rays; or the oil may be submitted to the above treatment and the steam passed over a catalyst, e.g. nickel. The oil vapours and steam then enter the fixation chamber. H. G. S.

378. Process for the Conversion of Mineral Oils and the Like, of High Boiling Point into Aliphatic Hydrocarbons of Low Boiling Point. F. W. Todt and P. Sumpf. E.P. 267,364 of 1926.

The process is specially adapted to produce high-grade motor spirit from crude oil and its fractions, as well as from lignite tar oils and similar hydrocarbon mixtures. Its success depends upon the following conditions: (1) Treatment of the oil is carried out in stages of increasing temperature, the initial temperature chosen being as low as possible; (2) The periods of

treatment are of short duration; (3) Highly porous, suitably heated distribution bodies like pumice-stone, animal charcoal, natural earths, chemically active coal and coke are employed to promote decomposition: contact surfaces of metal and the like are excluded; (4) The material under treatment at any one stage has boiling temperatures of exact or nearly the same degrees; (5) Mining of the products with unworked material is avoided. As an example, an American gas oil distilling between 230° and 350° C. was passed through a chamotte-lined iron tube filled with pumice stone at about 500° C. The emerging vapours were condensed by a dephlegmator and the heavier constituents, with boiling points above 190° C., were sent back through the pipe repeatedly till practically no residue boiling above 190° C. survived, the temperatures being raised by about 15° C. from stage to stage. The total yield of spirit was 77 per cent., there being no coke deposited in the tube or pumice.
H. G. S.

379. Method of Cracking Oil. F. E. Wellman. U.S.P. 1,616,521 of 1927 (Appl., May 7, 1923).

The chief aims of the method of cracking oils are to reduce deposition of carbon, to increase the amount of oil which can be treated in an apparatus of given content and to effect an economical improvement in the ratio of yield and quality of product. The still, which is preferably made up of a series of vertical tubes spaced in the form of a circle inside a furnace, is maintained filled to a certain point throughout the operation. Vapours are withdrawn through drums each superimposed upon several tubes and the reflux re-cycled, whilst heavy residuum is withdrawn from a point common to all the tubes. When the run has been half completed, the oil input and residue draw-off pipes are reversed to cause carbon to be deposited in those sections which previously have been relatively clean. The tubes are preferably heated by a rotating burner.
H. G. S.

380. Method of Cracking Oil. F. E. Wellman. U.S.P. 1,615,779 of 1927 (Appl., July 10, 1922).

The method of cracking oils consists in dividing the main body of oil into a number of smaller, connected bodies and applying heat individually and intermittently in constant rotation to each of the smaller bodies of oil. In the preferred form of apparatus, the cracking stock flows by gravity from a common tank into a ring of vertical tubes placed in a furnace. The tubes are heated by a burner which rotates at a constant speed inside the furnace, cracked oil vapours being taken through the oil supply tank to condensers, while heavy residue is withdrawn from the bottom ends of the tubes.
H. G. S.

See also Abstracts Nos. 280, 285, 294 and 301.

Oilfield Technology.

381. "Elbof" Method Indicates Oil by Electric Currents. Benjamin Andrews. *Oil Weekly*, April 29, 1927.

It is claimed not only that the area of a petroleum deposit can be outlined by this method, but also its depth from the surface with an approximation of the thickness of the oil stratum.

Electric currents are sent through the ground and the direction of these currents traced. When the path of these currents is abnormal, some disturbing element must be present in the ground. The "Elbof" method determines the nature of the disturbance and locates it.

Such disturbing element may consist of any substance whose electrical conductivity differs from that of the ground under exploration.

The electrical resistance of petroleum is higher than almost any known substance, being over 100,000 times as high as moist ground or sedimentary rock. It, therefore, causes the greatest possible distortions to the normal flow of electricity through the ground, and consequently it is the easiest of all substances to locate.

In the application of the " Elbof " method, two metal stakes in circuit with an alternating dynamo, are driven into the ground about 500 ft. apart, and current is sent from one to the other through the ground. The periodicity of the current must be in the range of audibility.

The electric current permeates the surrounding ground and sets up in every part of the adjacent area a magnetic field, with specific direction everywhere for normal electrical conductivity conditions.

Variations of conductivity will cause distortion in the path of the electrical lines which will in turn distort the direction of the magnetic field.

By means of a wired loop on gimbals with amplifying device and earphones the direction of the magnetic flux at previously surveyed stations can be determined by revolving the loop to the position where first the most, and then the least sound is heard.

By plotting the minimum sound positions of the loop, parallel curves are developed, and by their deviation from the normal curves it is possible to determine the character of the electrical conductivity of the underlying formations.

This method has reached that stage of development where oil deposits as deep as 6,000 ft. have not only been located, but their areas defined and their depth from the surface determined, and separate sands have been distinguished when lying one above the other.

Patents on this method have been granted in all the important countries of the world and application for patent is now pending with U.S.A. patent office. J. E. M. H.

382. Some of the Laws and Principles Controlling the Operation of the Air Lift. S. F. Shaw. *Oilfield Eng.*, May, 1927, 51.

The laws governing isothermal expansion of a perfect gas are set out together with tables showing the work done in isothermal compression and expansion of 1 cub. ft. of gas from atmospheric pressure. Another table shows the work done in raising one gallon of water to various heights. From these tables it is a simple matter to work out the volume of gas at any given pressure required to lift a liquid of known specific gravity through a given distance, assuming 100 per cent. efficiency. After explaining the manner in which the necessary work required to raise oil is obtained from the gas, the author goes on to demonstrate the almost misleading inaccuracy of the figure known as gas-oil ratio as an indication of efficiency. Two tables showing efficiencies and other data of both natural and artificial gas-lift wells are included, the five naturally flowing wells quoted varying in efficiency from 0·33—16·6 per cent. while the artificially-operated wells, of which ten examples are given, vary from 5·1—32·3 per cent.

The main factors governing efficiency are set out, and of these the design of the foot-piece and head-piece and also of the eductor may be improved by a study of the conditions. E. R. B. S.

383. The Gas Lift in Actual Practice. E. O. Bennett and K. C. Scalter. *Oil and Gas J.*, Feb. 20, 1927.

In the Panhandle Field of Texas two methods of starting gas-lift wells are employed :—

1. Gas is first admitted to the tubing and allowed to rise between the tubing and casing for about an hour, by which time the aeration of the column is sufficient to cause a flow from the well. As soon as flow starts the connections are reversed and gas pressure applied to the casing thus forcing back the aerated oil and starting a flow up the tube. Since the volume of aerated mixture between tube and casing is greater than the volume of the tubing a small lowering of level in the annular space due to applied gas pressure produces a large rise of the light mixture up the tube thus reducing the initial pressure required to start a well.

2. The second method called super-flushing requires a lower pressure and less time than any other. Gas is admitted to the tube until oil flows from the casing as before, but when flow has started a large volume of gas is suddenly released through the tube expelling practically all the aerated crude in the well. The direction of flow is then reversed and the flow started through the tubing. This method requires less time and lower pressures than any other, and flow into the tubing at the well-head is established within three minutes of super-flushing.

In the Panhandle fields the temperature in the oil-bearing strata is lower than elsewhere and only 25° F. drop in temperature between original temperature and set point is evident. Pumping, and release of pressure, cause evaporation of gas from the crude and lower the temperature beyond this limit, causing the oil to congeal. This cannot be obviated by external heating, but by the use of a "Flow Devil," consisting of two annular collars supported on a mandrel which is provided at its upper end with a standard pin. The lower sleeve serves as a cutter, while the upper is merely a guide. The "Devil" is run into the well on a sinker bar and set of short-stroke jars, and need only be applied once per day to keep the well free from solid paraffin.

Where wells produce water with the oil, a suitable adjustment of the back pressure either by varying the height of the tubing or by throttling the delivery will reduce the percentage of water or eliminate it entirely.

Keeping the gas factor as low as possible in wells being flowed by the introduction of extraneous gas re-cycled in connection with a gasoline plant, is of secondary importance when it is desired to obtain the maximum amount of oil by gas-lift methods.

As the natural pressure declines, a greater volume of extraneous gas can be circulated, causing increased aeration of the mixture in the flow line and a lower working pressure. A. R. S.

384. Potash may make dry hole Profitable. McNutt. *Oil and Gas Journal*, March 24, 1927.

Primary potash deposits are largely distributed in U.S.A. but normally expense of extraction and freightage exceeds the value of the deposit. In secondary deposits the easy solubility of potash content makes extraction inexpensive. The most promising outlook for the American potash industry appears to be its discovery in the South-West Peruvian Basin comprising part of South-East New Mexico and South-West Texas. An accompanying map shows the contours of the salt beds of this region, based on the logs of wells drilled for oil. One particular core test drilled is quoted and shows polyhalite at 700–990 ft. and sylvite at 1,212–1,466 ft.

The importance of polyhalite as a potash ore is questionable, but the core tests show that conditions have been favourable for the deposition of

beds of the minerals from which almost the whole of the world's supply is obtained. The actual richness of these beds is however still unknown.

A. R. S.

385. Use of Heavy Minerals in Rotary Drilling Mud in Ventura Field. C. C. Thoms. *Oil and Gas Journal*, **52**, 37, 96.

While drilling through caving formations or high pressure gas zones, great care is required to prevent freezing of the drill pipe, and to avoid blow out with the possible wrecking of the well. In fields presenting these problems, the weight of the column of ordinary rotary mud is not always sufficient to preserve the walls or hold down the gas. It has been found necessary, therefore, to increase the specific gravity of the mud by the addition of heavy minerals such as barite and hematite. When heavy mineral mud is required at a well, the weight is determined by gas conditions, and the required amount of mud (weighing from 80 to 90 lbs. per cu. ft.) is pumped into the well to fill it from the bottom practically to the top. At the conclusion of the operation, enough 98-pound mud is pumped into the well to fill the drill pipe. The object of placing the heavier mud in the well last is to maintain a slightly lower fluid level inside the drill pipe than in the well, so that a "dry" pulling job is secured.

The barite (s.g. 4·25—4·50) is ground before use, so that 98 per cent. will pass a 200—300 mesh screen. The hematite (s.g. 4·25) is powdered to pass 99 per cent. through a 20 mesh screen. The addition of heavy minerals to rotary mud in the amount used, does not greatly increase the viscosity of the original mud, but increases its weight to a marked degree. Heavy mineral mud is more effective in holding down gas than ordinary mud of the same specific gravity, because it is less viscous, and allows the gas to bubble through without decreasing its weight appreciably. There is very little difference in the results obtained when hematite or barite is used in the rotary mud. One characteristic of hematite, its constant red colour, has probably been the deciding factor in its general adoption, since from the colour alone it can be distinguished from the common rotary mud.

W. H. T.

386. Pressure Control in Flowing Wells. R. R. Brandenthaler. *Oil and Gas Journal*, 1927, **25** (48), 38, 94, 99.

Application of pressure to flowing wells must take into consideration the relationships between pressures in different parts of the system. These are :—

A change in rock pressure affects tubing, casing and differential pressure, but not trap pressure.

A change in tubing pressure affects casing and differential pressure, and a change in casing pressure affects tubing and differential pressure.

Trap pressures are not affected by rock, casing tubing or differential pressures unless the traps are overloaded.

Trap pressures affect differential, tubing and casing pressures, and any changes at the well head affect well pressures.

Fluctuations in trap pressures, when not overloaded, are due to changes in the gas line from the trap.

A six months' test was carried out during April–October, 1926, in the Mid-Continent district, all the twenty wells tested producing from the Prue sand. The usual procedure was to run 2-in. tubing to about the top of the sand, lay tubing, casing-head and flow connections, connect the flow line to the trap and place a gauge in one of the side outlets from the casing-head.

The well usually started to flow when casing pressure reached 200 lbs. or more.

After flowing through the tubing for several days, "beaning up" was started. To avoid rapid changes, flow nipples to reduce the diameter ¼ or ½ inch were inserted every three or four days.

Flow line pressures varied from 1 to 16 lbs., and trap pressures from atmospheric to 25 lbs. The average casing pressure ranged from 100 to 125 lbs. and tubing pressures from 15 to 25 lbs., the ratio of tubing to casing pressure averaging from 1:5 to 1:4.

Several shut-in pressure tests were made prior to control and in one case built up to 299 lbs. in 8 hours. In another it rose to 425 lbs. and in a third to 450 lbs.

As a result of the tests, flowing life was increased from 3 to 6 months, and in about half the tests the daily production was also increased.

To obtain the best results, wells should be tubed before heading starts, preferably when first completed. When the oil is on paraffin or mixed base, the tubing should not be set below the top of the sand. As rock pressure decreases, the depth of the tubing becomes most important. G. S.

387. Modern Sucker Rods Designed to Resist Fatigue Reduce Production Costs. Cassidy. *Oil Age*, April, 1927.

A brief résumé of the developments of the sucker rod as applied to oil wells is given and then follows a discussion of the quality of steel best suited to resist normal wear and tear. By judicious heat treatment and cold working of certain steels containing from 0·25—0·35 per cent. carbon, these efficiencies are greatly increased.

Some breaks are due to poorly forged ends, but the majority are due to fatigue. Study has shown that failure by so-called "fatigue" is brought about by conditions which do not affect the metal as a whole, but rather start a fracture at some particular point. Three theories of fatigue are given, the author preferring that of Merrils, who maintains that the process of fatigue failure is not one of persistent weakening of the metal until the resistance to fracture is less than the applied load, but rather that the metal acts as a reservoir of energy after it has passed the elastic period, and this accumulation of load during stressing becomes sufficient to overcome its strength. A. R. S.

388. Diesel Power for Drilling Operations. *Petroleum Times*, April 9, 1927.

The G–P Foos Diesel Rotary Outfit, designed by Messrs. Garvey and Palmer, is described. This consists of one Foos-type L three- or four-cylinder Diesel engine with one Foos gasoline auxiliary starting engine. The Diesel engines are hooked up with the specially designed G–P clutch. The four-cylinder unit develops up to 200 b.h.p. with a speed range of 400 to 900 r.p.m., the three-cylinder unit develops 70 to 145 b.h.p. The clutch exercises automatic control so that no excessive strain is put on the drilling equipment. When the limit of torque, fixed by the operator, has been reached the clutch slips indefinitely without excessive wear and tear, thus eliminating twist-offs. The engine develops full load within five seconds after starting from cold. All moving parts are completely enclosed. The combined weight of both draw-works and mud-pumps is 18 tons, compared to 300 tons for a corresponding steam plant. No stand-by losses are incurred, and no fireman is required. Owing to the very even torque available a straighter hole is drilled than with other equipment. Water consumption is negligible. The entire outfit

is very compact and transportable. In an actual drilling test a saving of over 70 per cent. was obtained compared to steam-power. W. N. H.

389. Drilling and Pumping Rig Equipment. G. McConnell. *Oil and Gas Journal*, April 7, 1927.

The paper reviews the present equipment used for drilling and pumping, and attempts to design a rig which can be converted from drilling to pumping with the least difficulty, i.e., by substitution of the prime mover only. The following conclusions are drawn :—

1. Rig equipment should be so designed and arranged that all cable-tool operation may be taken care of without replacing anything but the prime mover when a "driller" is converted into a "pumper."
2. No more of the standard A.P.I. equipment should be sacrificed than is absolutely necessary.
3. Belt-driven band wheels are not necessary, and high-speed belting only should be included in further transmission equipment for either drilling or pumping rigs.
4. Geared crank-shaft equipment for drilling is limited to use with electric motors unless present designs are greatly altered.
5. Standardisation will be aided and the oil industry will profit if rigs are capable of being driven by any choice of prime mover already in use.
6. Rig efficiency depends largely upon transmission equipment of careful design, to meet the conditions of service intended. S. W. C.

390. Methods of Making and Interpreting Oil Field Ground Water Analysis. Uren. *Oil Field Eng.*, May, 1927.

Methods of estimating silica, iron and alumina, calcium, magnesium, sodium, potassium, sulphate, chloride, carbonate and bicarbonate are given, then follows a suggested method of reporting in terms of "Reaction Coefficients of Radicles." The reaction coefficient is obtained by dividing the actual amount of the ion or radicle by its atomic weight. Thus all arbitrary units are excluded. A graphical method of reporting these values is suggested, followed by that of Stabler-Palmer. In this the values are reported as primary salinity ($SO_3'+Cl'$ with an equivalent of $K\cdot+Na\cdot$). Secondary salinity (If $SO_3'+Cl'$ is greater than $Na\cdot+K\cdot$, then the $SO_3'+Cl'$ not required by $Na\cdot+K\cdot$ is calculated to $Mg\cdot+Ca\cdot$).

Primary alkalinity (excess of $Na\cdot+K\cdot$, together with an equal value of $CO_3'+HCO_3'+S'$ (if sulphide present).

Secondary alkalinity (excess of $Ca\cdot+Mg'$, over $Cl'+SO_3'$, with an equivalent value of CO_3'). A. R. S.

391. The Results of Some Water Analyses from the Hanovarian Oilfields. Kauenhowen. *Petroleum*, April 10, 1927.

Salt water is present in most of the oil-bearing wells in the American fields and the author endeavours by the analyses of waters taken from different depths in the borings of two wells, to obtain evidence of the possible origin of the oil as well as of the decomposition of the oil-bearing rock.

A comparison of the four analyses detailed shows that in spite of great differences in the amounts of total dissolved solids all belong generally to the same type, as the ions of the strong acids present are equivalent to the sum of the ions of the alkali metals and the alkaline earth metals. In fact, a striking similarity to sea-water is evident. A. R. S.

392. Improvements Relating to the Resolution of Emulsions or Suspensions Containing Tar or Oil. E.P. 268,547. April 7, 1927.

The invention consists of a process for breaking aqueous emulsions of tar or oil by means of the addition of a finely-divided mineral powder. The powder used is finely ground granite or any other similar material which is more easily wetted with water than with oil. In the case of emulsions containing up to 35 per cent. of water, the powder is added to the liquid, and the whole mixed and heated up to 60° C. By this means, a high proportion of the aqueous phase is agglomerated as a thick mass. When the emulsion contains over 40 per cent. of water, it is added to the powder without heating, and some of the water thus separates out. More emulsion is then added, and the mixture is heated to a temperature of about 70° C. when the water will separate out practically completely. W. H. T.

See also Abstracts Nos. 333 and 336.

Petroleum Geology.

393. Present Stage of Oil Geology Reviewed. Statement of Conditions which are at present understood as necessary to the Occurrence of Oil. F. G. Clapp. *Oil and Gas Journal*, April 28, 1927.

The fundamental criteria which should generally be applied in searching for an oil or gas field in an untested region are considered to include the following:—

1. Do "surface indications" (seepages, etc.) exist?
2. Are the rocks of sedimentary origin?
3. Is the age of the strata similar to that prevailing in some existing oil or gas field?
4. Do porous beds exist in which oil may be held in commercial quantity?
5. Does a possible source of origin exist? If this be not apparent, may it nevertheless be present?
6. Does sufficient "cover" exist above the porous beds to prevent oil or gas escaping to the surface and being lost?
7. Are the strata so slightly metamorphosed by heat or pressure that the oil has presumably not been driven away?
8. Does geologic "structure" exist suitable for concentrating oil or gas in commercial quantity?
9. Are the hydrostatic conditions such as do not prohibit the accumulation of oil in pools?

Test wells can be safely drilled if every question be answered favourably. The writer only has in mind one fundamental criterion (e.g., No. 1) that can be answered in the negative and a reasonable prospect still remain of finding oil in a commercial quantity.

With two or more unfavourable answers prospects are unfavourable. Excepting 1 and 5, all criteria should probably be answered affirmatively if the district is to be considered favourable.

Besides the above criteria, however, certain "secondary criteria" are of importance, as affecting the question.

Fifteen of these are detailed: Existence of faults; occurrence of earthquakes; porous beds at too great depth; occurrence of porous beds on the surface; vertical position of the beds; sands wanting porosity; oil or gas present but unsuitable for commercial use in available markets; unsatisfactory relation between source of origin and the porous beds; influence of

volcanic or plutonic rocks; geologic structures of rare or unknown types; presence of artesian water affecting the oil concentration adversely; removal of oil already by human or natural agencies; age of rockfolding may be too late, permitting undue hardening or desiccation of the oil, etc.; relation of water level respective to local structure.

The author then classifies "surface indications" as oil seepages; natural gas seepages; outcrops impregnated with oil or bitumen; bituminous dykes; mud volcanoes; burnt clays; salt occurrences; sulphur occurrence.

He next classifies seepages as associated, or not associated, with igneous intrusions; discussing these he describes the other indications shortly, although he mentions that their presence may be unnecessary as a positive criterion.

The stratigraphic occurrence of oil and gas in various countries is then tabulated, and with some final remarks upon source of origin, reservoir rocks, cover rocks, metamorphism, and structural criteria, the conclusions are arrived at as follows:—

1. A dome or anticline of small size will now seldom be avoided by oil geologists.
2. A high dome or anticline is presumably advantageous.
3. Some geologists ascribe gas to broad anticlines and oil to narrow ones; these hypotheses, however, are unreliable.
4. In water-free sands a flat structural crest has generally trapped more oil than a sharp one. With watered sands little effect results from flatness.
5. The height of "closure" may mean much, or little; with great hydrostatic pressure oil may have been pushed out of a structure of slight vertical closure, but be held in one of considerable closure.
6. The size of "collecting area" is certainly important.

J. E. M. H.

394. Oil-Bearing Formations of South-Western Arkansas. *Petroleum Times*. Vol. 17, 421 and 423. Pp. 277 and 365.

This article presents a condensed description of the cretaceous formations which outcrop in South-Western Arkansas, north of Red River, and east of the Oklahoma line. It thus affords a guide to the interpretation of the logs of exploratory wells drilled in Southern Arkansas and Northern Louisiana, where these formations are under cover. The cretaceous formations consist largely of unconsolidated sand, clay and marl, with a few beds of limestone, sandstone and chalk. They rest on the planed-off edges of intensely folded and faulted Paleozoic rocks, dipping to the south and south-east at low angles. The cretaceous formations have long been divided into a lower and upper series of beds, known respectively as the Comanche and Gulf series which are separated by a pronounced stratigraphic and faunal break.

The Comanche series consists of the following formations:—(*a*) The Trinity formation, containing beds of gravel, sand, limestone, gypsum and red or variegated clay; (*b*) the Fredericksburg group, which is only represented by the Goodland limestone, the latter consisting of irregularly thick-bedded limestone, and some yellowish calcareous sandstone; and (*c*) the Washita group, represented by 20 ft. of grey marl and hard fossiliferous beds belonging to the Kiamichi clay.

The Gulf series consists in the main of nine formations as follows:—(*a*) Woodbine sand, consisting chiefly of sand and gravel, much of which is water-laid volcanic material. Because of its volcanic origin, the Woodbine sand is readily differentiated from the overlying Tokio formation. (*b*) Tokio formation which unconformably overlies the Woodbine sand, and

corresponds to the upper part of the "Bingen Sand." The formation consists chiefly of a series of clays, sands and sandstones. (*c*) Brownstown marl, containing beds of dark grey calcareous clay or marl, sometimes mixed with a small percentage of very fine sand. (*d*) Oyan formation, of sandy micaceous marl, and unconformably overlying the Brownstown marl. (*e*) Annona chalk, consisting of a massive and heavy-bedded white chalk, which is sparingly fossiliferous. (*f*) Marlbrook marl; this is here redefined as being restricted to the beds beneath the Saratoga chalk. It is a uniform chalky marl, which is dark blue when fresh, and highly plastic when wet. (*g*) Saratoga chalk, resting unconformably on the above formation. It is a comparatively thin formation ranging from 20—60 ft. in thickness. (*h*) Nacatoch sand—a complex unit composed of various types of sand, limestone, clay and marl. It can be divided into three lithologic units which are completely gradational one into another. (*i*) Arkadelphia marl. This is the uppermost formation of the Gulf series and overlies the Nacatoch sand unconformably. It consists almost exclusively of dark marly-clay and marl prevailingly free from sand and contains locally layers of dense concretionary limestone.

Tertiary rocks are represented by the midway formation and are separated from the Cretaceous Gulf series by a considerable unconformity, but the contact is not conspicuous owing to the general lithologic similarity of the beds above and below it. It is usually impossible to differentiate the Medway and the Arkadelphia on the basis of lithology, but it is believed that a rough separation of them could be readily accomplished by testing the well cuttings with hydrochloric acid. W. H. T.

395. The Salt Domes of Colorado, Utah. *Petr. Times*, 17, 430, 678.

The fact that a number of salt domes in Texas and Louisiana have proved to be highly productive of oil fully justifies a search for salt domes in other localities. The surface indications of the site of a salt dome are often little conspicuous. Frequently erosion has completely levelled down the original elevation, and the existence of the dome can then only be detected by geological study. Recently, geophysical methods have been successfully employed to locate domes which present no surface evidence of their existence. In Vol. II., *Bull. Amer. Assoc. of Petr. Geol.*, T. S. Harrison discusses the occurrences of salt domes in Colorado and the adjoining Utah territory. Several saline anticlines and plugs have been discovered along the Colorado-Utah border, and wells have penetrated salt in which appeared showings of oil and gas. These occurrences have been divided into four groups: (*a*) saline anticlines on which plugs have been developed locally, (*b*) saline anticlines which have not yet reached the plug stage, but on which local domes have formed comparatively recently, (*c*) arc domes which owe their existence to differential loading, and (*d*) the structural (Meander) anticline which occupies the Colorado River Canyon.

Many theories have been advanced to account for the formation of these salt masses. One of these theories is that the domes were formed by the growth of the salt crystals of the salt mass and the force that such growth exerts has lifted the original horizontal strata.

Harrison, however, assumes that the salt, originally in more or less horizontal beds has been made to flow by the pressure of the superincumbent rocks. Under this pressure the salt has behaved as a plastic body, and been forced to flow upwards in relatively weak zones to form domes and other elevated structures. The doubtful point is as to the nature and origin of the force. It is obvious, however, that the movement of the salt has, in many instances, produced structural conditions favouring the accumulation of petroleum

which may have been contained in the adjacent rocks. There is no reason to suppose that the oil is formed in the salt.

With regard to the saline structures of the Colorado-Utah area, the following are some of the more important: (1) a salt dome at Salt Creek, and a salt plug at Moab, in Grand County, Utah; (2) salt plugs at Paradox, and a salt dome at Dry Creek, Montrose, Colorado; (3) salt structures at Lisbon Valley, San Juan County, Utah, etc. The author is of the opinion that the oil possibilities of the Colorado-Utah saline structures justify a thorough testing. W. H. T.

396. Geology and the Petroleum and Natural Gas Possibilities of Palestine and the Sinaitic Peninsula. F. Julius Fohs, New York City. *Bull. of Amer. Assoc. of Petr. Geol.*, Feb. 1927.

The presence of asphalt and oil showings in the vicinity of the Dead Sea and near Hasberga, west of Mount Hermon, has long been known; and these, together with the asphalt-rock occurrences, have led many to believe commercial oil deposits might be found in Palestine. The so-called asphalt rock or bituminous limestone has no relationship to the occurrence of oil. The asphalt and oil seepages, where present along fault lines, signify nothing as regards commercial oil where they appear, except as they are suggestive that in localities where traps occur which have not been disturbed by faulting, oil may be present in commercial quantity.

Although all of Palestine is faulted into large fault-blocks, within such blocks there are thirty-seven structural domes which might act as traps for oil and gas; but where igneous intrusions occur with such structures it is less likely that they will produce.

Promising domes occur in Palestine west of the Jordan and the Dead Sea, with the possible exception of the basalt-covered areas. From the Jordan and the Dead Sea eastward to the Hedjaz Railway, because of the basalt intrusions and exposure of lower beds by uplift, there is very little promise, though some folds are probable in this area. Of a total of 12,700 sq. m. in Palestine proper, more than 300 sq. m. offer structural conditions warranting tests for oil and gas. This offers an unusual high percentage of possible oil-bearing area, considering the small size of the State.

The Sinaitic Peninsula also offers possibilities. The formations range from Eocene to pre-Cambrian. Cretaceous limestone and marls form the great bulk of the beds to be penetrated, and next below is the Nubian sandstone and several hundred feet of carboniferous sandstones, limestones and shales. There are eight possible oil-horizons, half of which have a good chance to produce.

With ample reservoir beds, with ample source material, and with good structural traps, we see every reason for the development of our oil supply in Palestine. We are anxious to see the development undertaken because it would speed the upbuilding of Palestine as nothing else can. J. E. M. H.

397. General Oil Geology of Colombia. A. H. Garner, New York. *Bull. of Amer. Assoc. of Petr. Geol.*, Feb., 1927.

The occurrence of oil-seepages in Colombia has been known since the days of Spanish occupation. It was not until the present year, however, that oil was produced sufficient for export.

Geologically the country may be divided into six distinct provinces, namely, Upper Magdalena River Valley, Coastal, Cesar River Valley, Maracaibo Basin, Llanos, and Atrato River Valley.

The only commercial production is obtained from the "Tropical" Co.'s property in the Upper Magdalena Valley, probably from Upper Eocene or

Lower Miocene. A small well (Eocene) has been encountered in the Maracaibo Basin. Coastal area development has not been successful, though small quantities of oil and gas have been encountered. Great thickness of sediments in Miocene and Pliocene and pressure of many seepages and anticlines, together with the accessibility, make it worthy of further testing. J. E. M. H.

398. The Search for Oil in New Guinea. Arthur Wade. *Bull. of Amer. Assoc. of Petr. Geol.*, Feb. 19, 1927.

Exploratory work in New Guinea is dangerous because of impenetrable forests, tropical diseases, unfavourable climatic conditions, hostility of uncivilised natives, and apathy of the Dutch in developing the area. The island of New Guinea is divided into three administrative parts—Dutch New Guinea, and two Australian mandates, former German New Guinea and former British Papua. The island is in one of the greatest zones of crustal weakness of the earth, which is described by a series of arcs extending from the Himalayas to New Zealand. Complex structural conditions are explained by great overthrusts. Tertiary sediments, intensely folded, mainly of shallow water types, contain the evidences of petroleum, oil and gas seepages, brackish springs, and mud volcanoes. Beneath the tertiary deposits the formations range from Mesozoic to Archæan.

A short discussion followed the paper.—(Nov. 17, 1926.) J. E. M. H.

399. Sedimentary Natural Gases from Oil and Coalfields of Japan. K. Uwatoko. *Bull. of Amer. Assoc. of Petr. Geol.*, Feb., 1927.

This paper has special reference to the geologic occurrence of these gases.

This paper is based on the results of an investigation of natural gas in Japan as conducted under the direction of the Aeronautical Research Institute of the Tokyo Imperial University. The author is concerned with the variation in chemical composition of natural gas with its modes of geologic occurrence.

In general natural gases are classified as (1) those of igneous or inorganic origin and (2) those of sedimentary or organic origin. The natural gases from quaternary formations contain mainly methane (CH_4) as the hydrocarbon compound, but the oil-bearing tertiary formations contain other hydrocarbons in addition. Some natural gases from the oil-bearing formations appear to show chemical variation with geologic conditions. Helium content of sedimentary natural gases from quaternary and tertiary formations is generally negligible. Several tables of chemical analysis accompany the paper.

J. E. M. H.

400. Geophysical Methods Now Used in Mexico. *Oil and Gas J.*, Mar. 17, 1927.

Torsion balance surveys have just been completed by Templeton and McCarthy, of Houston, for the Mexican-Sinclair Corp. The wells drilled on the recommendation of the surveys are said to have been good producers. J. C. Templeton has charge of this work in Mexico: he directed the torsion balance survey in the Gulf Coast region before going to Mexico. He had previously investigated the possibilities of geophysical prospecting for the Anglo-Persian Oil Co. The oil is confined to narrow fractured zones along fault places in the Mexican area surveyed. This presented difficult problems, necessitating the exact alignment and nature of the faults. Swamps, lagoons, and dense jungles cover the territory.

In lagoons the instruments and houses were erected on specially-constructed platforms. This method of surveying is said to be something new in geophysical exploration work. J. E. M. H.

401. Recent Salt Dome Discoveries in Texas and Louisiana-Gulf Coast Region. *Oil and Gas J.*, Mar. 31, 1927.

W. E. Pratt describes these, most of the domes having been located by the use of geophysical instruments. Some, but not all, have been proven as oil-bearing. The Boggy Creek Dome in Cherokee County, Texas, may be mentioned, where a big well was brought in recently.

At Spindletop a recovery of over three million barrels on 1¼ acres has already been recorded from off-side sands on the original Spindletop Dome, of which nothing was known a year ago.

New productions were mentioned on older known domes, including Piedras, Pintas, where two wells starting at 100 barrels an hour were drilled, South Dayton and South Liberty, etc., etc. J. E. M. H.

402. Generation of Oil by Geologic Distillation. J. L. Rich, Ottawa, Kans. *Oil and Gas J.*, Mar. 31, 1927.

In regions of intense mountain folding (Appalachians, etc.) we find black carbonaceous shales, which have lost the oil which presumably they once contained, and which is still present in equivalent rocks outside the metamorphosed zone.

At the time of mountain building the folding took place at great depth underneath overthrust sheets of perhaps Alpine proportions. Conditions would seem to have been favourable for extensive distillation of oil from carbonaceous beds. The escape of the oil and gas would escape laterally along the bedding and driven out to cooler zones under the influence of heat and the gases generated by the distillation.

By subsequent denudation of the mountain area and uplift the rocks primitively subjected to distillation would be brought up to the surface, their porous beds being opened to the inflow of meteoric waters. Artesian circulation would thus cause further distribution of the oil previously generated. A working hypothesis is advanced which recognises three zones: (1) zone of complete distillation—no oil remaining, (2) zone of distillation and secondary accumulation, (3) zone of secondary accumulation. J. E. M. H.

403. Geophysical Prospecting for Oil. J. C. Templeton. *Oil and Gas J.*, 1927, **25** (52), 42, 174.

The object of geophysical methods does not differ from practical oil geology, but they have the advantage of quickness and accuracy where surface exposures are scarce or entirely absent.

The principal methods are (*a*) gravitational, (*b*) seismic, and (*c*) magnetic, being based on some property of the rock, e.g. (*a*) difference in density of subsurface masses, (*b*) varying degree of elasticity, and (*c*) variation in magnetic content or magnetizable substances.

In the gravitational method, the instrument used is the torsion balance invented by Baron Eotvos. This method is the most widely used and has been successful in determining almost every type of structural configuration. It is particularly valuable in the location of salt domes and determines with considerable precision the limits of the cap rock, the steepness of the flanks and the position of any faults.

The successful discovery of salt domes by the seismic method is well known. In this method, vibrations are artificially produced by explosives and are transmitted through the rocks at speeds of from 400—4,000 m. per sec. according to their elastic properties. Records of the various waves are obtained by seismographs and studied.

In the magnetic method, local variations in the earth's magnetic force are determined by magnetometers. Of long use in locating ore deposits, this

method has recently been extended to the determination of main tectonic features and concealed igneous masses, and in the latter respect proves helpful in oil prospecting.

Generally speaking, the most accurate information is obtained by gravitational methods. G. S.

See also Abstracts Nos. 278, 279, 381 and 404.

Coal and Shale.

404. The Oil Shales of Tasmania. A. McIntosh Reid. *Pro. Roy. Soc. Tasmania*, 1926, **42**.

Tasmanite occurs in the North and North-Central districts of Tasmania, and is associated with Torbanite and the kerogenite and humic-kerogenite coals. The most important deposit extends from Latrobe to Chudleigh. The shale bed is 5–7 ft. thick, and lies at the same horizon as the coal, the two minerals never being found superimposed. The shale bed has everywhere two main layers, separated by a band of mudstone, which also contains tasmanite sporangia of cryptogams allied to the club-mosses. Identical marine and open estuarine fossils are found above and below the beds of tasmanite and of coal respectively. The shale contains numerous rounded pebbles. Oil is not present in tasmanite, but is generated by heating from the contained kerogen. The shale is light yellow or amber, stands weathering well, and ignites and burns readily. Its average yield of oil is 40–45 galls. per ton. Analysis showed 30·84 per cent. of volatile and 62·50 per cent. of ash. The crude oil contained N, 0·31 per cent.; H, 10·41 per cent., O, 4·93 per cent., C, 79·34 per cent., and S, 4·93 per cent., and had sp. gr. 0·931—0·956. Distillation of the crude oil yielded 10 per cent. of benzine and 80 per cent. of fuel oil, and from the latter 25 per cent. of lighting oils and 30 per cent. of lubricating oils were obtainable. The oils are of asphaltic base. The probable reserve of shale is estimated at 27,000,000 tons. The benzine produced is rich in aromatics, and a good anti-knock motor fuel. H. M.

405. The Turner Low-Temperature Carbonisation Plant. *Engineering*, 1927, **123**, 559–561.

The plant described and illustrated, the invention of C. Turner, is operated by the Comac Oil Company, at Coalburn, Lanarkshire. It is capable of carbonising 25 tons of coal per day in continuous operation and is at present giving a yield of 20 gallons of crude oil (tar) per ton of low-grade treble nuts from a local colliery. The coal is elevated into a hopper, whence it falls through a valve into a preheating chamber, and thence through a similar valve into the retort proper, there joining the mass of coal undergoing treatment. At the bottom of the retort, it comes under the action of an extractor screw which, rotating once per 18 or 20 minutes, cuts away the lowest layer of coke and delivers it, through a third valve, into a cooling chamber, and finally through a fourth valve into a movable hopper. The four valves referred to are operated mechanically by an endless chain so as to secure correct sequence of opening and closing. A reduction and variable speed gear allows the rate of travel of materials through the plant to be varied at will.

Heating of the coal in the retort is effected by means of superheated steam which enters at the bottom, the tar vapours and steam being liberated from the top through a valve of special design. This valve is adjusted to remain closed from 8 to 10 seconds, during which time a pressure of from 6 to 8 pounds per square inch is built up in the retort; the valve then opens and allows the

steam and volatiles to be swept out, first through a trap in which waxes are collected, and then through condensers. The intermittent effect of the valve is claimed to inhibit cracking of the tar, in that the increased pressure retards evolution of volatile matter whilst the sudden reduction in pressure accelerates its escape from the coal and the retort. The retort is constructed of iron castings, lagged on the outside but not lined internally, since it has been found that the steam covers the interior with a hard impenetrable scale which obviates the necessity for a brick lining. The crude tar contains 22 per cent. of phenols and gives the following fractions when distilled:—spirit to 170° C., 9 per cent.; kerosine, 170°—220° C., 18 per cent.; lubricants 220°—270° C., 18 per cent.; heavy oils 270°—350° C., 25 per cent., the residue being a crude soft wax. A 7-feet diameter retort has a capacity of 50 tons of coal per day. The maximum capital cost should not exceed £150 per ton daily throughput. Labour required is small, and the expected over-all cost is not greater than 3s. 3d. per ton of coal carbonised. H. G. S.

406. Studies in the Composition of Coal. The Resolution of Coal by Means of Solvents. C. Cockram and R. V. Wheeler. *J.C.S.*, 1927, 700–718.

A series of coals was fractionated into α, β and γ constituents by extraction with pyridine and chloroform and the last-named (chloroform soluble) still further resolved into light petroleum soluble (*a*), ethyl ether soluble (*b*), acetone soluble (*c*), and residue (*d*). Clarain from a South Yorkshire coking coal from the Parkgate seam gave 75·8 per cent. α, 17·3 per cent. β, and 6·9 per cent. γ constituents. The γ fraction consisted of 33 per cent. (*a*), 37 per cent. (*b*), 12 per cent. (*c*), and 18 per cent. (*d*).

By means of experiments involving destructive distillation, oxidation with hydrogen peroxide and nitric acid, and ultimate analysis, the compositions of the fractions were found to be as follows:—(*a*) saturated hydrocarbons 40 per cent., unsaturated hydrocarbons 40 per cent., resins 20 per cent.; (*b*) resinols, resins and resenes; (*c*) and (*d*) resin-like.

Treatment of the same coal with benzene under pressure at 200° C. and 285° C. gave respectively 5·96 per cent. and 7·3 per cent. of extract. The benzene-soluble extracts were fractionated in the same way, giving products similar to those obtained by the pyridine-chloroform method of extraction. The results of the work of Fischer, Broche and Strauch and of Bone, Pearson and Quarendon are compared with those of the authors. H. G. S.

407. The Active Carbon of the Urbain Process. *Petr. Times*, 1927, 17, 708.

A highly adsorptive charcoal is produced in the Urbain process by carbonising the raw material in presence of chemicals to yield an activated product directly. Thus a Dutch peat with a low ash content is mixed in the cold with from one-third to three-sevenths of its weight of phosphoric acid. The resulting gelatinous product is heated to 500° C. to expel water and to produce incipient combustion and is then transferred to retorts and carbonised at about 1,000° C. a little air being admitted to prevent reduction of the phosphorus-pentoxide liberated. The latter is absorbed in suitable towers, a 95 per cent. recovery of phosphoric acid being effected. The carbon is washed free from acid, dried at 500° C., sieved and sorted. Urbain carbon is used to recover light spirit from natural gas in Poland and Rumania: a single plant in Borys-law extracts daily 10,000 kilos. of light oil more economically than older recovery methods tried. It is also applicable to the recovery of volatile solvents, for the manufacture of gas masks and for decolorising pharmaceutical substances.

For gas-stripping purposes, vertical absorption chambers are mainly used, the towers being fitted internally with coils. During adsorption, cold water flows through the coils. When the carbon is saturated, the water is replaced by superheated steam, which drives out the adsorbed oil and leaves the carbon only slightly less efficient. H. G. S.

408. The Fuel Research Station. *Ind. Chem.*, 1927, **3**, 163—71.

An account, with illustrations, of part of the work carried out at H.M. Fuel Research Station at East Greenwich. The researches include a survey of the coal seams of Great Britain, high and low temperature carbonisation of coal, hydrogenation of coal by the Bergius process and the testing of fuels in a variable compression Ricardo engine and a Dorman engine. The low temperature carbonisation of coal is carried out on an intermediate scale in horizontal retorts and on a large scale in vertical, externally heated, continuously operated retorts which were maintained on stream throughout 1926. Good results were obtained with sized coal varying from non-coking to strongly-coking coals. Thus Mitchell Main nuts carbonised at 620° C. gave 15·3 cwts. of semi-coke, 13·1 gallons of tar and 4,860 c. ft. of gas per ton of coal.

The hydrogenation of coal is effected in a high pressure autoclave and in a continuous plant having a throughput of one ton of coal daily. The latter is housed in three separate but adjacent buildings, the mixing of the paste and compression of the hydrogen being carried out in one room, hydrogenation or conversion in the second and reception and separation of the products in the third. The charge of powdered coal is mixed with 5 per cent. of ferric oxide and 40 per cent. of a low temperature tar product and the paste forced at a pressure of 200 atmospheres into the first of three reacting chambers. The latter consist of steel cylinders 6·5 feet long and 8 inches internal diameter, the thickness of the walls being 2·25 inches. Each cylinder is contained in a gas-heated lead bath and is lagged on its upper surface by means of a cover. A rotating shaft fitted with blades serves to agitate the contents of each bomb. Hydrogen is pumped into the top of the first bomb, which acts as a preheater. The mixture enters the second cylinder at about 400° C., its temperature being raised to an unspecified degree and thence to the third cylinder, where it is heated to 490° C. The now liquefied "Bergin" product is next passed through two condensers in series. At this stage the pressure is released to 60 atmospheres in a separator, the gas from which passes to storage, whilst the liquid is conducted into a second separator maintained at atmospheric pressure. The oil is withdrawn as a fairly viscous fluid. Hydrogen for the process (2,000 cubic feet per hour) is generated by blowing steam over heated iron. H. G. S.

409. Hydrocarbons in Gas from the Low Temperature Carbonization of Coal. F. E. Fray and W. P. Vant. *Ind. and Eng. Chem.*, 1927, **19**, 488. (Compare preceding abstract.)

The gas was formed by carbonization of a Utah coal in a vertical retort at 700—725° C. in the presence of superheated steam. Analysis by the author's method (see preceding abstract) gave the following figures: carbon dioxide, 11 per cent.; hydrogen sulphide, 1 per cent.; nitrogen, 1·1 per cent.; oxygen, 0 per cent.; hydrogen, 33·5 per cent.; carbon monoxide, 11·7 per cent.; methane, 32·4 per cent.; ethylene, 0·9 per cent.; ethane, 3·8 per cent.; propylene, 0·9 per cent.; propane, 1·3 per cent.; butylene, 0·5 per cent.; butane, 0·4 per cent.; liquid hydrocarbons, 0·1 per cent. The 2- and 3- carbon atom fraction was shown to be free from acetylenic hydrocarbons.

The liquefied 4-carbon atom fraction was treated with bromine to convert the olefines and diolefines into addition products and these were fractionated under atmospheric pressure. The following hydrocarbons were shown to be present: 1, 3, butadiene, estimated as the solid 1, 2, 3, 4, tetrabromobutane (0·002 per cent.); ethyl ethylene, by the method of Wislicenus and Schmidt (*Ann.*, 1900, **313**, 212) (0·12 per cent.); unsym-dimethyl ethylene, by its selective absorption in sulphuric acid (0·21 per cent.) and sym-dimethyl ethylene by difference (0·18 per cent.). The presence of this last hydrocarbon was confirmed by conversion of the suitable dibromide fraction into the 2·3 diphenyl aminobutane hydrosulphate of Morgan and Skinner (*J.C.S.*, 1925, **127**, 1,734).

The saturated hydrocarbons freed by distillation from the olefinic debromides were shown by fractionation to be a mixture of 80 per cent. *n*-butane with about 20 per cent. of *iso*-butane. No *cyclo*paraffins were detected. A test is described for methyl *cyclo*propane. R. P. L.

410. Separation of Individual Saturated and Unsaturated Hydrocarbons in Coal Gas by Fractional Distillation. F. E. Fray and W. P. Vant. *Ind. and Eng. Chem.*, 1927, **19**, 488.

An analytical method for the estimation of methane, ethylene, ethane, propylene, propane, butylene and butane in coal gas is described. It consists in fractional distillation of the liquefied gas by the method of Shepherd and Porter (*Ind. and Eng. Chem.*, 1923, **15**, 1,143) supplemented by analysis by the Orsat method. The first fraction containing methane and inorganic gases is analysed in the Orsat apparatus. Subsequent fractions containing the two-carbon, three-carbon and four-carbon atom gases are collected over the ranges −143 to −139°, −114 to −110° and −85° to −82° C. respectively. These fractions after refractionation are treated with sulphuric acid solutions of silver and nickel sulphates in suitable concentrations to remove the olefines.

The method gave satisfactory results with mixtures of known composition and was found to take five to six hours for a complete analysis. R. P. L.

411. Manufacture of Useful Products by Oxidising Coal. W. A. Bone and R. Quarendon and Gas Light and Coke Co. E.P., 268,006, 1925.

Benzenoid carboxylic acids are produced by oxidising coal with an alkaline solution of an alkaline manganate or permanganate, either by boiling at atmospheric pressure or under pressure in an autoclave. Any type of coal may be employed but a bituminous coal reacts more quickly if its contained neutral oils and substances which cause its coking propensities are previously removed, preferably by extraction with benzene under pressure. Three examples are given. Brown coal or lignite is heated under a reflux condenser with ten times its weight of potassium permanganate and an equal weight of potassium hydroxide. The yield of benzenoid carboxylic acids, chiefly mellitic acid, is about 40 per cent. to 50 per cent. of the coal. A bituminous coal, or its residue after benzene extraction, on similar treatment or on heating in an autoclave gives 30 per cent. to 40 per cent. of carboxylic acids. H. G. S.

412. Distillation of Tar and the Like. W. B. Davidson, A. C. Michie, and E. W. Muddiman. U.S.P., 1,626,588, 1927 (Appl., April 23, 1926).

The object of the process is the dehydration and partial distillation of tars etc., and the provision of improved means for obtaining a distillate free from contamination due to frothing or priming. The raw tar enters the still at the bottom, the dehydrated tar being withdrawn continuously at a predetermined higher level. The still is fitted with a plurality of coils immersed in

the vapour space connected with a similar series placed below the level of tar. Steam or other heating medium is caused to flow downwardly through the coils, the heat so imparted bringing about distillation and simultaneous breaking of froth by contact of the latter with the coils in the vapour space. A vapour off-take pipe is also provided. H. G. S.

413. Method of Distillation. J. S. Morgan. U.S.P., 1,622,964, 1927 (Appl., January 30, 1923).

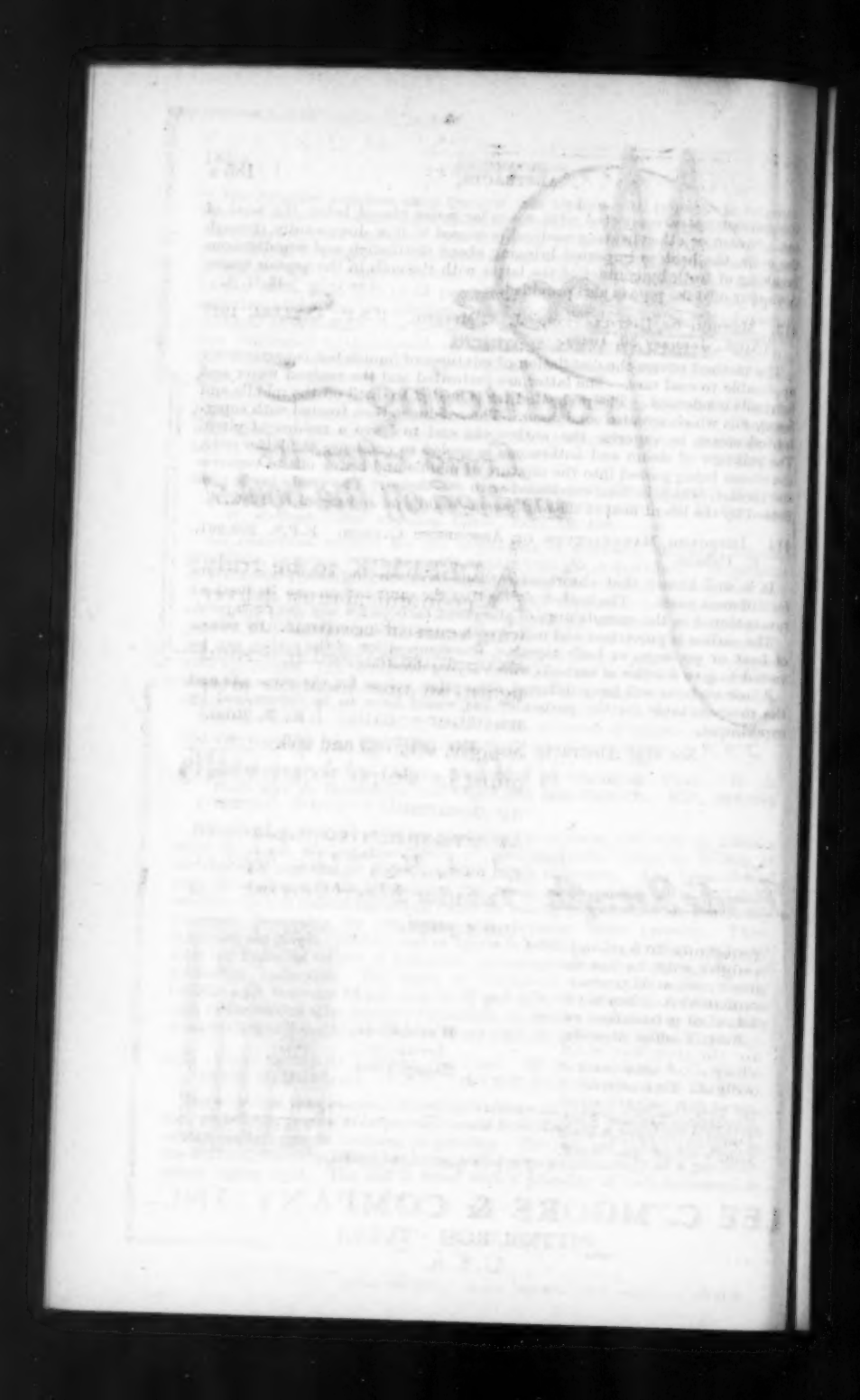
The method covers the distillation of mixtures of liquids but is particularly applicable to coal tars. The latter are preheated and the evolved water and light oils condensed. The preheated tar is heated to distil off the middle and heavy oils which are also condensed. The residue is then treated with superheated steam to vaporise the anthracene and to leave a residue of pitch. The mixture of steam and anthracene is cooled to condense the latter only, the steam being passed into the mixture of middle and heavy oils to vaporise the former, which is then condensed with the steam. The crude tar is preheated by the latent heat of the anthracene, middle oil and steam. H. G. S.

414. Improved Manufacture of Absorbent Carbon. E.P.S. 269,961. E. Urbain.

It is well known that absorbent carbons have varying absorption powers for different gases. The author claims that the same carbon can be used as raw material in the manufacture of absorbent carbons for any gas or vapour. The carbon is pulverised and mixed with some binding material. By means of heat or pressure, or both together, the composition of the carbon can be varied to give a series of carbons with varying densities.

These carbons will have different absorption values for the same gas and the most suitable for the particular gas would have to be determined by experiment. K. B. Ross.

See also Abstracts Nos. 300, 309, 352 and 353.



Abstracts.

Arranged by W. H. Thomas, A.R.S.M.

Abstractors.—S. W. Cooke, B.Sc., R. W. L. Clarke, B.Sc., P. Docksey, B.A., W. N. Hoyte, B.A., J. E. Marshall-Hall, A.R.S.M., R. Pitkethly, H. G. Shatwell, Ph.D., E. R. B. Skipwith, B.A., A. R. Stark, B.Sc., A.I.C., W. H. Thomas, A.R.S.M.

General.

415. Metal Alloys in the Mineral Oil Industry. *Petro. Times*, **18**, 445, p. 176.

The article is an abstract of a contribution by Dr. H. Magnus to "Die Metallborse." Reference is made to the much more severe demands made by the oil industry with regard to metals for various types of apparatus which has imposed new tasks on the metallurgical industry.

The problem is the production of material highly resistant to chemical and thermal influences. Modern methods of treatment of mineral oils, particularly by cracking processes with high temperatures and pressures, have created new problems with regard to the material for the necessary apparatus. The gaseous products of cracking, such as carbon monoxide and hydrogen sulphide, all tend to affect the material of the apparatus. In the processes of Nice, Blumner, Melamid and others, special problems arise through the tendency of the metal baths to alloy with the metal of the container, which not only destroys the apparatus itself, but also changes the properties of the molten metal and renders it unsuitable for the purpose for which it is intended. In cracking processes, the reaction products attack the iron of the cracking chamber, and a porous surface of the iron is set up which constantly enlarges the surface for attack by gases or molten metal. A partial remedy is the use of iron or steel of low carbon content; but inasmuch as the material is required to possess very considerable strength at relatively high temperatures, it requires the addition of other metals which will ensure this. The addition of aluminium produces a material resistant to the influence of high temperatures, but the alloy is brittle and has a high coefficient of expansion.

A nickel addition to the iron is free from these disadvantages, and the replacement of carbon by silicon results in a material which meets most of the demands made upon it. For reactions in which no very strong stresses are set up, a surface treatment of the iron or steel by a suitable metallic spray suffices, or the iron may be calorized or sheradized. In order to study the reactions of a molten metal on the walls of a container made of some other metal, a number of tests have been carried out on various heat-resisting metals in a bath of molten tin at temperatures from 550 to 600° C., the period of the test being 100 hours in each case. Monel metal appears to have been completely destroyed as such; wrought iron lost 28 per cent. of its weight, nickel-chrome steel 7 per cent., V2A steel 2·1 per cent., thermailid (brittle) 1·9 per cent., while a still more brittle variety was unaffected. Of four

silicon steels of different silicon content, only one showed a loss of 2·8 per cent., the other three showed no loss or only an inconsiderable one. Metallic alloys have lately come to be important as catalysts in the splitting up, as well as in the synthesis of mineral oils. When used as a contact agent, the surface properties and the crystalline structure of the metal or of the alloy are of the greatest importance. Metal catalysts which sinter at high temperatures become inactive; for this reason it is improbable that molten metal can act as a catalyst to accelerate hydrogenation, although it seems it can act to accelerate cracking. In the Melamid process of liquefying coal, the latter is mixed with metals or alloys that become molten at the temperature developed and form a mobile mass with the coal. The gravity of coal is about 1·3, while that of the metal may be assumed to be 7 to 8; this means the employment of a great excess of metal in view of the fact that two volumes of coal are used to one volume of metal. The process results in a solid residue of 25 to 30 per cent. of the original coal, while the iron and copper always present in the coal will alloy with the molten metal, so that after a time it will be necessary to resort to chemical or other expensive means to purify it. For such reasons this process will compare unfavourably from an economic standpoint with the Bergius process. In conclusion, it is pointed out that the numerous patent claims of different interests in this field tend to limit progress, and also that a pooling of knowledge and experience is very desirable.

W. H. T.

416. Glaucosil as a Purification Agent. J. W. Turrentine. *Oil and Gas J.* June 9, 1927.

Glaucosil is the name given to a form of silica produced by digesting greensand with sulphuric acid. The preparation of silica from this material presents several advantages to the producer. The raw material is obtained in a fairly finely divided state, and the sand yields a quantity of potassium and aluminium sulphates as the result of acid treatment, so that this step in the manufacture results in the formation of an easily recovered by-product. The greensand suffers a 50 per cent. loss upon acid treatment.

It is claimed that glaucosil is superior to clay or fullers earth as a decolorising agent, and has the merit of being easily separated by filtration. The effectiveness may be increased by grinding to a finer state of division, so that the absorbent property would not appear to be due to a surface condition produced in the manufacture from greensand.

Glaucosil may also be used to decolour other liquids than oils, and as a drying agent for gases.

It is stated that glaucosil may be easily regenerated, but no mention is made as to what extent this process affects the decolorising value of the material.

P. D.

417. Treatment of Water to Prevent Corrosion. Baylis. *J. Ind. Eng. Chem.* July, 1927.

The electrochemical theory of corrosion is based on the fact that metals such as zinc and iron tend to go into solution in water with the liberation of hydrogen. With zinc in contact with a solution of p_H value below 6·5, much zinc will be found in solution when equilibrium is established. The zinc in solution is not due to the oxide, but largely to soluble salts of zinc. With p_H above 7·5 the amount of hydrated zinc oxide which can exist in solution appears to be considerably less than 1 part per million. These figures apply to systems where the temperature is below 60° C. The much greater tendency for zinc to corrode at higher temperatures may not be so much a function of the solubility of the oxide as that it fails to form an impervious coating.

There is no treatment which, applied to water for domestic uses will prevent the corrosion of a fresh iron surface. Protective coatings are slowly built, but protective coatings are essential, even although their action is merely to delay corrosion till a more durable protective coating is formed.

In domestic water supplies the saturation equilibria of both ferrous and ferric hydroxides are low, the more soluble ferrous hydroxide having a very low saturation equilibrium above p_H 8·0. A curve of the approximate solubility equilibrium of calcium carbonate in absence of free oxygen is given, and it is shown that there is a tendency for all the iron forced into solution to be precipitated at hydrated ferrous oxide when the p_H is above the curve.

Corroding iron tends to precipitate calcium carbonate from solution, due to the fact that it has the power of removing all the free and approximately half the bound carbon dioxide from the water.

Coal tar coatings applied to iron pipes are not found to be highly satisfactory. They break down in from five to ten years. Holes soon form in such coatings, probably due to the fact that originally they are not entirely impervious.

Cement-lined pipes have been in use in some parts for up to fifty years and are still satisfactory. Hydrated portland cement gives up calcium hydroxide to the water and thus gives a solution saturated with lime in contact with the iron pipes. This alkalinity is sufficient to stop corrosion in a very short time. Also cement becomes carbonated if exposed to air, the depth to which the carbon dioxide penetrates being dependent on the porosity of the sample. But where the calcium compounds have not been carbonated, the tendency to corrosion is less because water absorbed by the porous lining is kept there by the impervious carbonated surface formed, the alkaline water thus giving permanent protection to the iron pipe. A. R. S.

418. Process for Removing Suspended Matters from Oils and Organic Solvents. H. Hey. U.S.P. 1,633,941. June 28, 1927.

The precipitation of impurities is effected by mixing intimately with the hot oil or cold solvent one, or a mixture of the following substances: Sulphonated oils; aqueous or alcoholic solutions of sulphonated oils; aqueous or alcoholic solutions of sulphonated oil soaps of potash, soda or ammonia. The sulphonated oils are produced by the action of strong sulphuric acid on oleic acid, ricinoleic acid, their glycerol esters or parent oils, such as olive oil, castor oil, etc. The surface tension of the finely divided water is lowered and, together with the finely divided solid matter, it settles by gravity from the oil or solvent.

The impure liquid is pumped from a low level storage tank to the top of the reaction and settling tank, the reagent solution being introduced during its passage thereto. It can be drawn off from the bottom of the settling tank and pumped again to the top to give complete mixing of the ingredients. On stopping the circulation the impurities settle to the bottom of the tank, and the two layers can be drawn off separately. It is found that 100 galls. of oil can be clarified by mixing with it 1 pint of sulphonated oil, followed by one hour's settling. S. W. C.

419. Process for Removing Suspended Matters from Oils and Organic Solvents. H. Hey. U.S.P. 1,633,942. June 28, 1927.

The invention is a furtherance of U.S.P. 1,633,941 and provides that the sulphonated oils, produced by the action of strong sulphuric acid on oleic acid, etc., may be diluted with a hydrocarbon solvent for oils such as petrol, benzol, etc., before being added to the oil to be cleansed. S. W. C.

420. Process for Improving Mineral Oils and Tar Products. Siemens and Halske Aktiengesellschaft. E.P. 263,186. July 7, 1927.

Mineral oils and tar products frequently contain substances which are easily attacked by oxygen, and which also tend to polymerisation. According to this invention, mineral oils and tar products can be freed from easily oxidisable substances containing sulphur and nitrogen by treating them with ozone in the presence of inorganic adsorbing bodies. For the purpose of the process a container is filled with the adsorbing bodies, the ozone being passed upwards, while the oil to be treated flows downwards over the adsorbent. For the complete removal of acid ingredients from the oil, it has been found best to mix the adsorbing bodies with a basic substance such as calcium oxide, barium oxide or magnesium oxide. W. H. T.

See also Abstracts Nos. 490 and 492.

Crude Oil.

421. Apparatus for Treating Crude Oils. H. A. Hopkins. U.S.P. 1,621,782. March 22, 1927.

The invention relates to the treatment of oils highly impregnated with water or sand, and which are usually burnt as refuse oils. The apparatus consists of a long cylindrical casing with a conical base, the interior of which is filled with a series of four concentrically spaced tubes. Through the closed tubes steam is circulated, whilst the oil is forced up the annular spaces between. In its passage it becomes rapidly heated and the water it contains falls back to the bottom by reason of its gravity. So that from the top of the cylindrical casing comparatively clean oil is withdrawn, whilst the water and sand collecting in the conical base can be withdrawn from time to time. The oil enters from a preheater into the top of the conical base, where it receives a washing with hot water. It is then forced up the various annulli, where the water becomes separated, finally leaves the top of the casing and flows as a clean oil away to storage tanks. S. W. C.

Natural Gas.

422. Selecting the Proper Absorption Oil for Use in Natural Gasoline Plants. Campbell. *Oil Age*, July, 1927.

In experiments using a glass model absorber containing three sections, the tortuous path pursued by a bubble in passing from one orifice to the surface of the oil has been noted. This buffeting, combined with eddying of the bulk of the oil, causes complete disruption of many bubbles while the rest become distorted.

The oils giving best results are those which froth readily and also break from froth with equal readiness, as the oil should pass down the column from plate to plate without any entrained gas. A. R. S.

423. Chemical Composition of Natural Gas. Garner and Miller. *Oil and Gas J.*, June 16.

For the most part natural gas is composed of paraffin hydrocarbons, carbon dioxide, nitrogen and helium. The hydrocarbons present are usually those from methane to octane. Some gases of special interest exist, containing nitrogen up to 10 per cent., carbon dioxide above 10 per cent., organic sulphur compounds and in Louisiana one well gives a natural gas which

gives a condensate in the drip pipes pale straw coloured and with an odour similar to turpentine. This consists mainly of naphthenes and hydroxylated carbon compounds which decompose on boiling.

Tables of actual analyses follow with a detailed method of analysis.

A. R. S.

424. Production of Helium Commercially. Moore. *Oil and Gas J.*, June 16, 1927.

Helium is found widely distributed in varying amounts up to almost 2 per cent. in natural gases from many petroleum wells. It is extracted by liquefaction of the hydrogen, hydrocarbons and carbon dioxide, with which it is accompanied in a plant similar to that used in liquefying air and then it is separated from the nitrogen by reducing it to the temperature of liquid nitrogen at a pressure of 1000 lb. sq. in. Thus helium of 93—94 per cent. purity is obtained.

Two theories of the origin of this gas exist, the first being that helium is of primordial origin. The other assumes that it is produced by the degradation of radio active material, but then this would require diffusion of the helium through several miles of the earth's crust in order to obtain the concentration present in natural gases.

A. R. S.

425. Pressure Regulation as Applied to Natural-Gas Gasoline Industry. J. V. Thomas. *Oil Field Engineering*, May, 1927, 71.

A general description of the principle and operation of diaphragm controlled pressure regulators, together with a list of all the common modifications with their application and uses in the natural-gas gasoline industry.

E. R. B. S.

426. Process of Converting Methane Gas into Hydrocarbons of Higher Carbon Content. Le Pétrole Synthetique Société Anonyme and A. Follict. E.P. 271,767. June 2, 1927.

The invention is a modification of E.P. 261,267. This consists in subjecting the methane to a gradual heating followed by a sudden cooling when the highest temperature has been reached, the products of reaction being kept under a vacuum until completely cooled. It has been found that the output in ethylenic hydrocarbons is increased with a higher vacuum and the modification provides for one of 40—50 cms. of mercury. Under such conditions the use of refractory walls of tubes is not advisable, and these should be replaced by metal walls or tubes coated or lined with a suitable refractory material, for instance, tubes of iron coated with silica.

S. W. C.

427. Improvements in or Relating to Adsorption Apparatus. The Silica Gel Corporation of Maryland. E.P. 255,819. June 29, 1927.

The apparatus consists of stationary inlet and outlet conduits for the fluid under treatment and for the reactivating fluid, while the admission and exit of these fluids to and from the absorber is controlled by rotary plate valves.

A. R. S.

See also Abstracts Nos. 441, 451, 455, 457, 488 and 490.

Motor Spirit.

428. Natural Gasoline Aids Performance. *Oil and Gas J.*, p. 34. June 2, 1927.

The obtaining of volatility in a motor fuel by high heating of intake manifolds is undesirable, and it leads to reduction of power and increases the tendency of a fuel to knock. Moreover, low volatility leads to crank case dilution.

Volatility can be increased (1) by limiting the amount of material which is vaporised at higher temperatures; (2) by including a sufficient quantity of low boiling point material to volatilise the heavy ends. The first method increases volatility at high, the second at low temperatures.

As the result of bench and road tests it was found that although a low end-point in a fuel may shorten the warming up period, it causes loss of power and poor acceleration when the engine is thoroughly warm, particularly with a heated intake manifold. The best fuel is one having a low initial boiling point and a fairly straight distillation curve to a moderately high end point.

An apparatus is described for measuring volatility: The fuel is placed in a burette, and it is displaced from this by a plunger falling at a uniform rate; the fuel overflows through a tube leading to the equilibrium coil, which consists of 20 ft. of 1 in. outside diameter copper tubing coiled in a helix 5 in. outside diameter. Air, dried by refrigeration, is brought to a known temperature by passage through a coil immersed in a thermostat, and is passed at a known rate with the fuel downwards through the equilibrium coil. The resulting liquid fuel is collected at the end of the coil. About 12 lb. of air are supplied per 1 lb. of fuel.

Between the limits of 30 per cent. to 60 per cent. vaporised it was found that E.A.T. = ½(A.S.T.M.—200) where E.A.T. = equilibrium air temperature ° F., and A.S.T.M. = A.S.T.M. temperature ° F. Thus the A.S.T.M. distillation can be interpreted in terms of true volatility. W. N. H.

429. Hydrocarbons Occurring in Commercial Gasoline. Reid. *Refiner*, June, 1927.

Four tables are given of the paraffinoid, olefinic, naphthenic and benzenoid hydrocarbons normally present in motor spirit.

The non-detonating qualities of these series are agreed to increase in the above order, and the view is expressed that the greater the gravity in comparison with the boiling point, the greater is the antidetonating quality.

Where formerly there was a tendency to add natural gasoline to spirit to give it light gravity, there is now a tendency to add aromatic and naphthenic hydrocarbons to increase the anti-knock value, employing just sufficient natural gasoline to give the desired volatility. A. R. S.

430. Fuel for Internal Combustion Engines. Col. Sir F. L. Nathan, K.B.E. *J. Soc. Chem. Ind.*, June 17, 1927.

The paper gives a review of the fuels which are and could be used for internal-combustion engines and of the possibility of producing and using these within the British Empire.

Petrol derived from crude oil is the most widely used fuel at present. The original straight-run supplies are being more and more supplemented by cracked spirit and casing-head gasoline. This will no doubt further increase the supplies, but it is estimated in the U.S.A. that there are but six years' supply of crude oil in the present known fields. It would, therefore, seem that some substitute for petrol should be found immediately.

A certain amount of benzol is at present produced in the gas works and coke oven plants. This quantity might be increased by the recovery of benzol in every gas or coke-oven plant in the country. But, on the other hand, there is a tendency towards decrease of supplies owing to a more general introduction of vertical retorts with steaming, which reduces the quantity of benzol produced. Another by-product of the coal-gas industry is tetralin produced by hydrogenating naphthalene. This is used along with benzol and alcohol in Germany to-day. Its commercial production, however, is a matter of price.

Alcohol is a fuel which can be used either alone or in admixture with other fuels. But its commercial production is a matter of price. If petrol were to become scarce it might then compete. It is possible to produce it from raw materials growable in this country—viz., potatoes, mangolds, Jerusalem artichokes. Sufficient acreage would not be available in ordinary times for the cultivation of the raw material, and also the best raw materials are also important foodstuffs. In the Empire overseas, where large tracts are available and where labour is cheap, some success might be met with. The best chances, however, are in those countries where sugar cane is grown, as alcohol can be produced fairly cheaply from the molasses. Sulphite waste liquors, ethylene and carbide are other possible, though almost negligible, sources of supply.

Liquid fuels can be obtained from the low-temperature carbonisation of coal. A great deal of work has been done at the Fuel Research Station, but the process is still in the experimental stage. It is estimated that this source could supply more than a fifth of the present motor fuel requirements of this country. There are also other processes, such as the Bergius, which aims at the complete liquefaction of coal. Other methods have been tried in both Germany and France, whereby it is sought to build up liquid hydrocarbons from carbon monoxide and hydrogen.

Coal gas is a fuel which came into great use during the war, but for some reason has not established itself, owing possibly to difficulties of supply in a convenient form.

Producer gas is a fuel upon which a great deal of work has been done in France owing to the desire to be as far as possible self-supporting in the matter of fuel for internal-combustion engines. Trials have been organised each year since 1922 with motor lorries fitted with suction-gas producers, for the most part burning wood charcoal. It is, however, most suitable for heavy traction.

It is not possible to predict which, if any, of these sources of supply will develop so as to provide fuels for internal-combustion engines to take the place of petrol commercially. It may very well be that before the supplies of motor spirit from petroleum and shale are exhausted, some other form of propulsive power may have superseded it. S. W. C.

431. Treatment of Petroleum Products. J. C. Black. U.S.P. Re. 16,679. July 12, 1927.

The patent describes a process of purifying acid treated synthetic or cracked petroleum products having the boiling point of gasoline. The material is first treated with a relatively weak alkaline solution in order to neutralise partially the acid treated product. The alkaline solution is then separated off and a quantity of relatively strong alkali added. The mixture is heated under pressure to a temperature not exceeding 350° F., and subjected to continuous agitation in order to break down the gums and gum-forming constituents. The alkali is next separated off, and the treated petroleum mixed with crude oil containing a percentage of gasoline. Subsequent distillation serves to produce a properly refined spirit, leaving the gums and polymerised materials in the crude oil residue. W. H. T.

432. Production of Benzene from Phenolic Vapours and a Reducing Gas. A. Irinyi. E.P. 273,493. July 7, 1927.

At about 750° C. phenol and hydrogen react to form benzene. The patent relates to very careful temperature control whereby the two gases are separately heated to the desired reaction temperature and are then allowed to mix. W. N. H.

433. Motor Fuels. J. la Riboisiere. E.P. 257,613. May 19, 1927. Conv. date, Aug. 26, 1925.

The fuel consists mainly of hydrocarbon, to which is added a small quantity (1–3 per cent.) of aromatic amine and a small quantity (up to 1 per cent.) of an ether or a ketone. W. N. H.

See also Abstracts Nos. 422, 467, 470 and 486.

Kerosine.

434. Automatic Vacuum Oil Lamp. *Engineering*. Aug. 5, 1927. 167.

A new type of incandescent mantle oil-gas lamp is now being supplied by Vacuum Power, Limited, which has several advantages over existing types. Normally lamps of this kind have their oil supplied to them from a close vessel charged with air under pressure, and it is necessary occasionally to pump additional air into the oil tank. Also the oil supply pipe is under pressure, and if a leak should develop the whole of the contents of the reservoir may be forced out. In most cases a pressure fed lamp must be extinguished before the oil vessel can be recharged. The new lamp suffers from none of these disadvantages, since it draws its oil by an automatically produced vacuum from a reservoir at atmospheric pressure, and as a consequence is self-acting, may be charged while burning, and since the supply pipe is under reduced pressure will draw air in through any leak instead of losing oil.

The outstanding feature of the new lamp is the automatic oil pump actuated by the heat of the burner. This consists of a small tube, heated by being placed close to the mantle, which is initially full of oil. As the temperature rises the oil is partially vaporized, thus forcing oil back down one of the connecting tubes and through a valve to the vaporizer of the burner. A point is reached where the condition becomes unstable and the vapour in the tube condenses, producing a partial vacuum and drawing oil through a second valve from the reservoir, the cycle of operations being then repeated.

To ensure regular action of the pump it has been found necessary thoroughly to scour out the heated tube after every action, and this has been accomplished by designing the supply connection so as to produce violent turbulence whenever oil is sucked in. An air cushioning chamber is provided between the pump and the burner vaporizer, which maintains a reasonably constant pressure at the vapour jet. Several lamps may be run off one supply main, any number of them being in use at the same time. The lamps are started up by simple heating with a torch as in most types of oil-gas burners, and a cleaning device for the gas delivery nipple is incorporated in the design. E. R. B. S.

435. An Improved Process for Refining Mineral Oils and/or Their Distillates. The Burmah Oil Co., Ltd. E.P. 273,351. June 27, 1927.

This invention relates to an improved process for refining mineral oils and their distillates, by removing therefrom aromatic and unsaturated hydrocarbons as well as their polymerisation and oxidation products. This removal of impurities is effected by treating the oil with pure phenol or a mixture of pure phenol with cresylic acid, containing 5 to 15 per cent. of water, the treatment being carried out at a temperature below 60° C. The mixture, containing preferably equal volumes of phenol and oil, is agitated in a mixing vessel and afterwards allowed to rest. The liquids separate into two layers, the lower one consisting of the phenol and adsorbed substances extracted from the oil. The treated oil is washed with caustic soda solution and then with water, the phenol being recovered subsequently from

the alkali wash by acidification. The phenol and extract are treated with 10 to 20 per cent. of cold phenolic water. The oil obtained on settling is identical to the original untreated material and is returned for retreatment. The phenol and extract are next mixed at above 70° C. with 10 to 12 volumes of hot phenolic water and separated at 90 to 100° C. The hot phenol water solution is cooled to below 40° C., and the resulting emulsion broken by filtration and separated. The phenol is subsequently concentrated in a still to 110 to 120° C. The extract is again washed with a large excess of hot phenolic water and separated. Finally, the extract may be washed with caustic soda solution in order to prepare it for subsequent use.

W. H. T.

436. Improvements in and Relating to the Purification of Liquid Hydrocarbons. Allgemeine Gesellschaft für Chemische Industrie. E.P. 258,846. June 30, 1927.

In order to minimise the loss of liquid sulphur-dioxide in the cycle of the Edeleanu process, the oil, which may be kerosine, gas oil or lubricating oil, is first treated with gaseous sulphur-dioxide in a packed tower before being subjected to the actual treatment with the liquid reagent. A. R. S.

See also Abstracts Nos. 416 and 469.

Lubricating Oil and Wax.

437. The Volatilisation and Carbonisation of Oils for Cylinder Lubrication. J. W. Donaldson. *J. Soc. Chem. Ind.*, **46**. 324T.

The usual physical tests of specific gravity and flash point give practically no indication as to how the oil will behave in service. Viscosity gives a rough indication of the suitability of an oil for a particular purpose. The loss in weight, due to the oxidising effect of air and evaporation, together with the production of carbon deposits at temperatures met with in large oil engines, are of considerable importance, and have to be considered in preference to the common physical tests in selecting an oil for cylinder lubrication.

A testing apparatus, which is a modification of Archbutt's Vaporimeter is described. It consists of an essentially electrically heated tube furnace of conventional design and arrangements by means of which heated air can be passed over the surface of the hot oil in a weighed boat.

Successive small quantities of oil (0·5g) were heated to 350°, 400°, 450°, 500°, and 550° F. in a weighed boat in a weighed glass tube. Air heated to the same temperature was drawn over the surface of the oil at the rate of 2 litres per minute. The loss in weight and the character of the residue were noted. Determinations were made after 15, 30, 45, and 60 minutes heating and also with boats having areas of 0·5, 1·0, 1·5, and 2·0 sq. in. Fresh quantities of oil were used for each determination. A large number of oils have been tested and the data from three oils of different character are given to show generally the results obtained.

The physical characters of the oils dealt with are :—

	A	B	C
S. G. at 60° F...	0·931	0·914	0·908
Flash Point F.	353	443	488
Viscosity at 100° F.	720	1800	3960 secs.
140° F.	190	400	900 ,,
180° F.	87	170	420 ,,
Colour	pale.	reddish green.	dark brown.

The results obtained are plotted graphically.

Increasing either the temperature, the time of heating or the area exposed is accompanied by increasing loss of weight. With the same oil, increasing the area exposed by four times has approximately the same effect as quadrupling the time of heating. At the higher temperatures 480 to 550° F., the condition of the oil after heating—i.e., whether still fluid, gummy, or solid—depends on the area over which it has been exposed. The lighter bodied oil A., although volatilising at lower temperatures, does not carbonise until the bulk of the oil has evaporated and therefore remains longer a lubricant, and when it does carbonise the deposit obtained is small. The heavier bodied an oil is, although the temperature of volatilisation is higher, the smaller the bulk to volatilise before carbonisation takes place and the heavier are the carbon deposits. Generally it is advisable to use the minimum quantity of as light a bodied oil as possible, consistent with good lubrication and the temperature of running parts, so as to obtain the smallest quantity of carbon deposits. R. W. L. C.

438. The Separation of the Components of Petroleum—The Isolation of Waxes from Untopped Crude Oil without Pyrolysis. Gordon and Marshall. *J. S. C. I.* July 15, 1927.

The work was carried out on Crude Persian petroleum using the Hele-Shaw stream-line filter, and the residues and filtrates under differing pack and oil pressures were examined.

That solid waxes are present in naturally occurring crude oil and can be separated from it without distillation or any other form of heat treatment involving pyrolytic decomposition of complex components has thus been definitely established. Edge filtration appears to establish conditions in which a protective colloid is unable to function and an apparently colloidal material was actually isolated. The removal by solvents of this material renders possible the crystallization of the wax, and in one case rendered possible the coagulation of the remainder by cooling.

Using oil topped by open steam at 100° C., the residue or edge filtration is diminished, and the theories advanced in this connection are that either steam at 100° C. destroys some of the colloidal asphaltic material, or that the presence of light components with or without added solvent is necessary to cause the separation of colloidal components or that the difference is due solely to surface tension and viscosity change. A. R. S.

439. The "White Oil" Reaction. Lee. *J. S. C. I.* July 22, 1927.

White oils made from petroleum distillates are stated not to have been present in the distillates before treatment, but to be by products and generally isoparaffins.

Oils made without cracking generally consist of a mixture of members of a definite series, and when the actual cleaning up or removal of unsaturated bodies by sulphuric acid is finished, the reaction proceeds differently—namely, the molecular condition of the compounds present is altered.

It is found that by treatment of an oil of known gravity with sulphuric acid a certain definite amount of white oil of a certain gravity is obtained, and the reaction comes to a definite end. Using successive washes with acid of known strength the alteration in physical constants of the oil can be determined, and thus the crude oil from which the oil was produced can be identified by means of comparison with a curve. A. R. S.

440. Carbon Deposits of Heavy Motor Oils. C. J. Livingstone, S. P. Marley, W. A. Gruse. *Oil and Gas J.* June 30, 1927.

The carbon produced in the cylinder of a testing engine when four different oils were used as lubricant was estimated under standard conditions. The

oils consisted of two blended oils containing residues, and two distillate oils. The runs were made under conditions such that the cylinder head temperature was maintained at 495° F., and the oil temperature in the crankcase at 158° F.

The results of runs on these oils are recorded on a graph, which also shows the results of similar experiments described in an earlier paper, in which a lower head temperature was maintained. The graph shows the relation between the carbon deposited (in grams per litre of oil used) and the Conradson value for each oil, and indicates that for any particular head temperature the relation between the carbon deposit and the Conradson residue is a straight line. The line for the lower temperature is more steeply inclined to the Conradson axis than is the other—i.e., as the head temperature rises the Conradson value has less effect on the value of the carbon deposit.

The mechanism by which carbon is produced in the cylinder is the same as that taking place in a Conradson residue test. For this reason it is advisable to use as volatile a lubricating oil as possible consistent with the correct viscosity.

The effect of giving an oil a drastic clay treatment appears to be to reduce the Conradson value to a limit at which it gives no indication of the carbon produced in the engine. P. D.

See also Abstracts Nos. 436, 445, 448, 452 and 469.

Special Products.

441. Carbon Black a Vital Business Need. Catt. *Oil and Gas J.* June 16.

The natural gas used in the preparation of carbon black is first scrubbed to extract the gasoline present and then burned in an insufficiency of oxygen for complete combustion. This black, mixed with mineral oil, is used for printing inks, 1 lb. being sufficient to blacken approximately one acre of paper. Impregnated in rubber, it is found to increase the life of the rubber, and, in fact, such a mixture is found to resist the action of a powerful sandblast much better than iron. A. R. S.

442. Improved Process for Splitting Fats and Oils. E.P. 261,707. June 30, 1927. I. G. Farbenindustrie Aktiengesellshaft.

The oil or fat is treated with a sulphonated aromatic mono or polycyclic hydrocarbon, or one of its salts, which contains in the nucleus a methyl or an ethyl group, together with an alkyl, aryl, aralkyl or alicyclic residue of high molecular weight. A. R. S.

443. Process for the Production of Bitumen or Oil Emulsions. H. E. Potts. E.P. 271,177. May 24, 1927.

The invention consists in adding liquid factis oil, made by the action of sulphur chloride on train oil to a bitumen heated to 210 to 230° F. This bitumen may be obtained from petroleum, or may be natural, or may be a coal tar product. A solution of caustic soda is then added in small portions at a time, stirring the whole time. This is then run with about half its weight of water containing a trace of sodium carbonate into a Plausen percussion mill and emulsified. It has also been found that the addition of sulphurised resins to the factis oils gives an emulsion resistant to the action of sunlight as regards softening or becoming sticky.

It is claimed that this gives an emulsion which can be diluted with water or aqueous solutions of alkalies or soaps, and which on spreading and drying gives a solid mass of high viscosity and weather-resisting power. S. W. C.

444. Improvements in or Relating to Bituminous Emulsions for Use in Connection with the Making and Surfacing of Roads and the Like. Universal Rubber Paviors (Manchester), Ltd., and S. J. Peachey. E.P. 273,031. June 30, 1927.

This invention describes a method of improving the properties of bituminous emulsions intended for use in connection with road surfacing. The main object of the invention is to increase the cohesion, resilience, strength and adhesiveness to road surfaces of the bituminous coating left after the evaporation of the contained water. This object is effected by adding to the emulsion, during or after its preparation, a suitable proportion of gutta-percha pitch, or balata pitch, or a combination of both. The addition of these substances is carried out at a temperature of 212° F. and with the aid of vigorous agitation.

W. H. T.

See also Abstract No. 424.

Analysis and Testing.

445. Extraction of Amorphous Wax from Laboratory Specimens of Oil. S. Bowrey. *J. Soc. Chem. Ind.* June 17, 1927.

The waxy oil is mixed with about 1½ volumes of petroleum naphtha and placed in a triple walled, unsilvered vacuum flask. This has the "pip" cut off from the inner jacket and connected to a sulphur dioxide syphon and a water pump. By half filling the jacket with liquid SO_2 and evaporating it under partial vacuum, the oil mixture can be cooled at any desired rate or maintained at a particular temperature without causing sufficient convection to hinder the settling of the wax. Success depends entirely upon the prevention of convection. By this means it is possible to chill, settle and separate a charge within 90 minutes. By settling at minus 20° F. oil having a cold-test of 25-30° F. is obtained.

S. W. C.

446. A New Thermoregulator. Collins. *J. Phy. Chem.* July, 1927.

The apparatus consists of an insulated tank in which the regulator is immersed. The heating is done by 110 volt alternating current and is conducted through the liquid, a solution of salt in water, from two copper electrodes, one of which is contained in a gooch funnel. The regulator consists of a pivoted horizontal tube, at the ends of which volumes of air and ether vapour or other liquid gas are entrained by a continuous mercury seal. Clamped to this tube at its point of equilibrium at the desired temperature is a vertical shaft bearing a glass plate of area greater than that of the gooch funnel containing the electrode. As the regulator tube moves from the horizontal plane due to the differential expansion of the liquids causing movement of the mercury along the tube, so the glass plate alters the area of the conducting zone between the electrodes. The variation in resistance thus produced brings about the desired alteration in heat input.

It is claimed that at low temperatures the variation should not exceed ·02° C.

A. R. S.

447. New Method for Flash Test. Downey. *Refiner.* June, 1927.

Attention is called to the fact that in many designs of flashpoint apparatus no adequate provision is made for eliminating local overheating. The amount of decomposition in the cup is proportional to the amount of heat applied and to the time of exposure to such heat. Thus it becomes perfectly obvious that the heating rate must be controlled within narrow limits for uniformity of results. In the cups having no stirring arrangements the oil

becomes overheated at the edges, with consequent concentration of the vapours at the point where the igniting agent is applied. It is claimed that there is a lag of from 10–15 Fahrenheit degrees with some thermometers, but this can be overcome by regular standardisation.

In the A.S.T.M. flashpoint it is suggested that the test flame be lowered to the level of the cup rim, $\frac{1}{8}$ in. from the circumference and correspondingly raised $\frac{1}{8}$ in. before reaching the other side. This is done because it is claimed that, due to creeping of the oil, a thin film, considerably overheated, is left, and by its ignition this causes a result of 10–15° lower than when the modification above is used to be obtained. A. R. S.

448. Lubricating Oil Tests. Evans. *Gas and Oil Power*. July, 1927.

The existing tests for lubricating oils are objected to because of their lack of universal adoption, their failure to give all the required particulars and their too complex nature for the unskilled operator. The new tests suggested are as follow:

The sample is heated in an iron pot until sufficient vapour is produced just to sustain a blue flicker of flame across the surface. This temperature is recorded as the "Fire Test."

The sample is cooled in a standard tube till no movement is apparent in three seconds while the tube is held horizontally.

The sample contained in a small beaker is touched with a metal rod heated to about 1000° F. If water is present it is detected by a slight frying noise.

The Redwood viscosity is recorded at 70°, 140° and 200° F.

For low temperature viscosity the oil is placed in a standard tube immersed in a bath at the required temperature. The tube is held horizontally and the time taken for the oil to flow to a definite mark on a gauge is noted.

Equal parts of distilled water and oil are placed in a standard tube and thoroughly mixed for a given time at 100° F. The amounts of water, emulsion and oil separating out after 1 hour, 24 hours and 14 days are recorded.

The sample is maintained in a standard tube at 500° F. for 200 hours, after which the evaporation is read off, the viscosity at low temperature is recorded and the characteristics of the residue noted.

For measurement of resistance to extrusion an anvil block with an accurate surface is fitted with a spherical plunger of equal area to the block face, and this plunger is free to move in the cylinder. A small contact spring and insulated bush is provided. The duct is connected to a hydraulic accumulator having a constant and definite fluid pressure, while there is a drain, galvanometer and 1·3 volt cell in series. A. R. S.

449. Conditions of Flow in the Vertical Capillary Tube of the Saybolt Thermo-Viscometer. W. H. Herschell. *J. Ind. Eng. Chem.*, **19**, 7.

This paper gives the results of experiments performed in order to estimate the agreement between the observed time of flow in the Saybolt viscometer and the time as derived from the theoretical equation embodying the viscosity surface tension and density of the liquid and the dimensions of the apparatus. If the constant $\frac{1}{32}$ in the formula is replaced by the experimental constant $\frac{1}{29}$ good agreement is obtained.

Besides estimating the error due to divergence in the constant, the author gives a table showing the effect of variation in the size of the capillary.

It appears to make no difference to the concordance of results whether the starting point for the time measurement is taken when the tube is completely empty or when the liquid has risen to the lower mark on the capillary. P. D.

450. New Tests of Bureau of Standards. Kern. *Oil and Gas J.* July 21, 1927.

The Bureau will not recognise the determination of viscosities at any other temperature than 100° C., using the Saybolt viscometer. Herschel's viscosity diagrams are recommended for determinations at other temperatures.

An apparatus consisting of two gear boxes with a train of gears in each, so arranged that the load on the teeth can be altered by means of a torsion device, is being used to determine the efficiencies of gear oils.

The detonation bomb used consists of a vertical steel cylinder closed at each end, the plate on the top having a portion of the metal removed so as to leave a thin diaphragm about 2 in. in diameter. On this rests a steel ball. The charge of oil and air is kept in the bomb under accurate temperature control and the fling of the ball is taken as a measure of the tendency to detonate.

Three methods are used to measure crankcase dilution. The oil is distilled from a 250 cc. flask into a glass funnel having a capillary about 3 in. long sealed on to the stem. The spirit thus flows very rapidly through the capillary, but the lubricating oil builds up above. The volume of diluent can be read off.

In the second method the oil is distilled into a graduated vessel containing a few cc.'s of a benzol-spirit mixture of gravity ·83. As soon as the distillate running down the side of the receiver starts to sink to the bottom the volume is read off.

In the analysis of cup greases, two copper plates, each having shallow slots cut in the inside faces, approximately 2½ cms. wide, 7 cms. long and 1 cm. deep, are clamped together. The slots end in a short tube. Heat is applied to the backs of the plates after the slots have been filled with grease. As the grease begins to drip from the short tube the temperature is read, while the time of flow, at this temperature, of a definite volume of oil is taken as the viscosity. A. R. S.

451. Specific Gravity of Gas. E. L. Rawlins. *Oil and Gas J.* July 14, 1927.

There are five types of apparatus in common use for determining the specific gravity of a gas. In all of them a direct comparison is made with air. The Schilling apparatus depends on the time taken by a gas to diffuse through a small orifice, usually a hole in a thin piece of platinum foil. It is easily constructed, but in order to obtain even reasonable accuracy great precautions must be taken. The individual peculiarties of each orifice make it necessary to perform a standardisation against some more reliable type of instrument, and even when care is taken the error may be as great as 10 per cent.

The gas density balance is accurate and easy to use. The principle upon which such balances work is that of measuring the buoyancy of a small metal float, suspended on one arm of the balance, when hung in air and in the gas. Instead of adding weights to counteract the effect of change of gas density, the pressure of the gas is varied and is read on a mercury manometer. Two types are used, the Edwards and the Pierce improved gas density balance. They are essentially the same in construction, but the latter introduces various improvements in the design which increase the accuracy and sensitivity.

The Precision gravitometer acts on the principle of observing the difference in pressure due to equal columns of air and gas. The apparatus responds fairly quickly to changes in density and may be made recording by allowing the gas to flow through it.

The Acme gravitometer is also recording, and depends upon measuring the buoyancy of a large container filled with gas and hung in air. It does not respond very rapidly to changes in the gas density. P. D.

452. Improvements to Machines for Testing Resistance to Wear, Lubrication Properties, etc. M. Spindel. E. P. 271, 328.

The improvements are made upon a testing machine described in No. 197,730. In testing the wearing properties of a substance to rolling friction, a cylinder of the substance is driven frictionally by a disc, the edge of the disc cutting a groove in the cylinder, the size of which measures the amount of wear. The load on the surfaces in contact may be varied, and by pivoting the frame the machine is made to register the coefficient of friction of the surfaces.

In order to test the effect of rolling friction at different velocities, the cylinder and disc may be replaced by two cones placed so that the small ends are together.

There are two methods which may be employed for testing wear under both sliding and rolling friction. In the first two cylinders of material are employed, one driving the other, the axes of which are placed at an angle. Or two cones may be used, the axes of rotation being placed so that the large end of one rotates and slides against the small end of the other.

The wear of fabrics may be measured by fixing a band of fabric in the machine so that it is drawn tight against the edge of the driving disc.

A tank enclosing the rotating members, on the rotating disc and the fabric belt in contact with it, makes it possible to observe the effects when various lubricants are present. An arrangement for supplying heat to the disc and rotating cylinder is also described. P. D.

453. Specific and Sensible Heats of Petroleum Oils. O. G. Wilson] *J. Ind. Eng. Chem.*, **19**, 7.

Two nomographic charts have been constructed by means of which it is possible to read the specific heat and sensible heat (above 0° F.) for an oi of known S.G. at any temperature up to 1000° F. The charts are based on the formula for specific heats evolved by Fortsch and Whitman, and are subject to the limitations of their equation. Although the charts are carried up to 1000° F., the equation itself is based on experiments at temperatures below 500° F., nevertheless experience has shown that specific heats up to 800° F., as scaled from the charts, are useful in engineering calculations. P. D.

See also Abstracts Nos. 423, 429, 437 and 438.

Refinery Plant.

454. Gas Regulator Design and Operation. T. H. Kerr. *Oil and Gas. J.* June 16, 1927.

The type of gas regulator controlled by a weighted lever rather than a spring finds favour with those who have only a very limited technical knowledge. The type of regulator has undergone great changes in the course of evolution to its present form, and these changes are discussed both with regard to the causes necessitating them and unexpected improvements which followed in their wake.

Gas regulators of this type suffer from cooling owing to the expansion of the gas, with consequent sticking of the valves. The main changes in design were in order to overcome this difficulty, and to make the regulator operative

when only a small amount of heat was supplied from outside. Besides eliminating the troubles due to excessive cooling, the changes also resulted in increased sensitiveness. When the valves close the equilibrium of the regulator depends on the gas pressures and the counter-balancing weights and may be regarded as static. While gas is passing through the valves the equilibrium is partly static and partly dynamic, depending on pressure changes due to the velocity of the gas. For this reason the regulator loses a considerable amount of its sensitivity. P. D.

455. Fundamentals in Vapour Enrichment. E. G. Ragatz. *Oil and Gas J.* June 9, 1927.

The author explains the partial vapour pressure curves for a mixture of two liquids, and describes the operation of a simple still for separating such a mixture. P. D.

456. New Method of Reducing Evaporation. C. O. Willson. *Oil and Gas J.* July 7, 1927.

The Standard Oil Co. of Kansas have introduced a system worked out at Indiana, with modifications to suit the local conditions. Six gasoline storage tanks are now connected by breather lines to a single gas bag of 18,000 cu. ft. capacity. This gas bag collects the expansion from the tanks during the day and provides for the return of gasoline vapours at night, when the tanks cool down. Any excess vapour which cannot be stored in the gas bag is pumped away to the gas recovery plant. Similarly, if necessary, gas can be supplied from the gas recovery plant when contraction is so great that the gas bag is incapable of dealing with it. The gas bag is made of cotton fabric impregnated with a mixture of glue and glycerol, so that it is impervious to the gasoline vapours and any naphtha condensate which may be formed therein. It has to be protected by a water trap in the inlet line, as the coating is soluble in water. It is claimed that evaporation losses are greatly reduced by this means. S. W. C.

457. Orifice Meter in Measurement of Gas. A. E. Young. *Oil and Gas J.* June 16, 1927.

This description of the orifice meter is for the man who has little or no previous knowledge of the subject. The principle of the meter is described simply, and its construction in practice is illustrated by drawings. The variables which must be allowed for in using the meter are discussed, and the reader is given practical advice on such points as the situation of the meter, general operation of care in upkeep necessary to insure accuracy. P. D.

458. Improved Method of Expelling the SO_2 Gases from Mixtures of SO_2 Gases and Oil. Allegemeine Gesellschaft für Chemische Industrie B.H.M. E.P. 269,118. July 7, 1927.

The apparatus described consists essentially of a vertical pipe or pipes surrounded by a welded on heating jacket. The pipes are attached to the bottom of a horizontal drum. This drum is provided with a gauge glass and also carries a dome fitted with an inspection glass. SO_2 gas passes to the condenser through an outlet on the dome. The oil saturated with SO_2, such as would be obtained in the Edeleanu refining process is fed in continuously at the bottom of the vertical pipes, and passes away from an outlet at the bottom of the upper drum through a regulating valve. The oil

passing away from the apparatus contains only as much SO_2 as corresponds to the condenser pressure, that is when heated to 60° C. and at 4 atmos. pressure about 3 per cent. SO_2. R. W. L. C.

459. Improvements in or relating to Polymerizing Oils. E.P. 246,491. June 22, 1927. The Barrett Company of New Jersey.

The oil flows from the storage tank, in quantity determined by an automatic valve arrangement, into the polymerizing vessel which is kept at 0° C. by means of a cooling coil. The oil is caused to circulate in the polymerizer by means of a pump, and the suction of this causes sulphuric acid or other polymerizing agent to be syphoned from a storage tank into the system. The treated oil is then neutralized by caustic soda. A. R. S.

460. Fluid Separator. G. M. Kirkpatrick. U.S.P. 1,630,748. May 31, 1927.

The invention is an improvement on a previous patent, serial number 699,809. It provides for a column wherein are placed batches of baffle plates, the column being divided into partitions whereby the gas is made to flow in a circuitous route through the baffle plates. Various inlet pipes are spaced down the column, these being provided with nozzles, so that a reflux liquid entering may be sprayed upon the baffle plates. After draining from one series of baffle plates the liquid runs down a collecting trough and, missing the next series, is run over the third series of baffles. In this way the gas is continually rid of entrained liquid by the baffles not washed with reflux liquid. One reflux liquid is drained off before the next is introduced. In this way, for example, benzine may be refluxed at the top of the column, kerosene in the middle, and gas oil at the bottom of a column attached to a crude oil topping still. The invention is not confined to fractional distillation, but may be used for separating and purifying gases and vapours under various conditions. S. W. C.

461. Carbon Removing Mechanism for Stills. James M. Wadsworth. U.S.P. 1,624,083. April 12, 1927.

This patent covers a still, and the internal mechanism so arranged as to scrape deposit from the bottom and discharge it through an opening, the whole mechanism being unaffected by unequal expansion of the still.

The still described is horizontal and elongated. The scraping device is mounted on a transverse carrier and may consist either of a chain or else of one or more weighted scraping blades rubbing on the bottom of the still. The scrapers are moved longitudinally in the still by a pair of endless chains passing over sprocket wheels mounted on transverse shafts disposed at each end of the still, and the carriers are supported by a track enclosed in the still which may be made of commercial rolled sections such as I beams. This track is rigid in itself and has bearings which carry the cross-shaft with its sprockets at one end of the still, where it is itself supported in such a manner as to allow for expansion. At its opposite end the track is supported by bearings on the other cross-shaft, an extension of which passes through a stuffing box to a source of power outside the still for driving the scraper mechanism. The tracks guide the carriers with their scrapers along the bottom of the still from one end to the other and back at a higher level, so that all deposit is carried to an opening in the bottom near one end of the still whence it is periodically allowed to escape.

Since the whole mechanism is rigidly connected to the shell of the still at one end only, an unequal expansion cannot be detrimental, and there is little liability of the scraping devices failing to operate properly. E. R. B. S.

462. Control System. George W. Wallace. U.S.P. 1,624,294. April 12, 1927.

This patent covers a control system such as may be applied to a still for cracking hydrocarbons, the control being almost entirely automatic and including means for shutting down the still automatically should any abnormal conditions develop.

The oil level is controlled by a method which utilises the fact that there is usually a difference in temperature of about 100° F. between the surface of oil in a still and the vapour immediately above it. A cell enclosing gas or volatile liquid is placed inside the still at the desired oil surface level and is connected to a pressure-gauge. The position of the oil surface relative to this cell will influence the pressure, and suitably placed contacts on the gauge body and pointer may work relays connected with mechanism for opening or closing a valve on the oil-feed line, which valve may or may not be interconnected with another valve controlling the supply of fuel to the heating furnace. The gas pressure in the still is controlled by a pressure-operated outlet valve.

In the fuel and oil-feed lines are valves held open by a trigger mechanism against the action of a spring, which trigger mechanism may be released by de-energising an electro-magnet, so closing the two valves and shutting down the still. This safety device may be operated from a number of causes. For instance, pressure-gauges coupled to cells above and below normal oil level in the still could be made to close down the still if the oil level rose or fell beyond predetermined limits through the closing of circuits through suitably placed contacts on the gauges and pointers. Similarly an ordinary pressure-gauge could be made to release the trigger mechanism in case of abnormally high or low gas pressure developing in the header.

In stills which contain mechanism such as moving chains driven by an electric motor for removing carbon an ammeter may be connected in series with the motor, and in case of abnormally high or low currents such as would be caused by tangling of the chains or excessive carbon deposit on the one hand or by breakage of the chains or connections on the other, the closing-down mechanism may be released and also the small cleaner motor be stopped. The automatic control may be rendered inoperative when starting up the still until approximately correct conditions have been attained by hand adjustments. E. R. B. S.

See also Abstracts Nos. 415, 417, 421, 422, 425 and 427.

Engineering.

463. Treatise on Counterbalancing from Engineering Standpoint. Mark P. Burke. *The Oil and Gas Journal*, June 23, 1927, 84.

The necessity for counterbalancing the forces encountered in the pumping of wells is set out and also the possibility of doing so by means of the centrifugal counterbalance.

The counterbalance on the band-wheel may be set to equalise rod weight only, or it may also take into account fluid friction and momentum. The first system will give considerable improvement over an unbalanced arrangement, but not to such a marked degree as the second. The centrifugal counterbalance itself has a large flywheel effect, but the driving motor is subjected to a more nearly uniform load if a flywheel is interposed between the driving mechanism and the reducing gearing.

In an unbalanced plant it is found that the load reaches a maximum value after the crank has made about three-eighths of a revolution from the dead centre at the beginning of the working stroke, there being no load during

one-half of a revolution. This is obviously unsatisfactory, but by suitable balancing the load may be made almost uniform throughout the cycle, reaching, however, equal maximum values during up and down strokes.

The load on the rods is derived from several sources; the weight of the rods themselves, the weight of fluid lifted, the friction of the fluid in the casing, the momentum of the rods and fluid, and the catching up of the fluid after the plunger has moved some distance and attained a certain velocity on the working stroke. The late pick-up of fluid on the up stroke may be caused either by the action of gas or by slack rods, and it is the shock resulting from this which causes a large number of rod breakages. The effect of gas may be counteracted by a proper gas anchor or, sometimes, by pumping with a short fast stroke. Slack rods are caused by inefficient counterbalancing as the load slows up the driving mechanism on the lifting stroke, but as soon as the lifting stroke is completed and the load on the driving motor is removed, the motor speeds up and the rods are forced down at a greater speed than they would fall freely, owing to the restricted oil passages through the plunger. The result is that the plunger does not make its full stroke, and does not start its upward motion until after the crank has passed well over dead centre. With efficient counterbalancing the maximum and minimum rod tensions are increased, owing to the more constant speed of the crank, which does not slow down on the up stroke or speed up on the down stroke, the plunger travel is increased, and consequently the oil output is increased. This should be remembered when comparing power consumed with and without counterbalancing and results reduced to a work-per-barrel basis. E. R. B. S.

464. Internal-Combustion Engine with Variable Compression. *Engineering*, May 27. p. 638.

The engine is made by Messrs. Ricardo and Co. to meet the demands for a smaller and cheaper variable compression engine than that produced in 1920. The engine has a bore of 2⅞ in., stroke 3¼ in.; the valve gear is of the Vurt and McCollum single-sleeve type. The variation in compression ratio is obtained by raising or lowering the cylinder crown only. A cone-shaped combustion space and a centrally-situated sparking plug are employed. The head is made up of an inner and an outer casting, the former extends above the cylinder and is threaded on the outside; the corresponding nut is in the form of a hand-wheel to which is secured a central sleeve. The cone is formed in the lower end of this sleeve, a second set of inner rings form a seal between the sleeve and the surrounding inner casting. By turning the hand-wheel the cone is raised or lowered, thus enabling the compression ratio to be varied between 5 : 1 and 10¾ : 1, while the engine is operating at full load. A micrometer scale operating on the mesh of the hand-wheel gives an accurate reading of the compression ratio for any setting of the cone. An injector is employed to circulate water in the cylinder and head jackets. An accurate fuel measuring device, measuring ¾-pint direct, is employed. The air supply to the carburettor is drawn through the base plate; an electric heater is inserted immediately before the carburettor.

A built-up crankshaft on ball-bearings is employed, also a Duralumin connecting rod and an aluminium alloy piston. The engine is designed for speeds up to 4,000 r.p.m. Two inlet and two exhaust ports are placed in the cylinder, normally one of each type of port is plugged. Coil ignition is fitted and a Zenith horizontal type carburettor with a variable jet. W. N. H.

465. Improvements in Kerbside Petrol Pumps. *Petroleum Times*, May 28, 1927, 1009.

A British patent has recently been granted to Mr. Malcolm James Crawford and the Wayne Tank and Pump Company for an invention relating to a method and apparatus for automatically filling receptacles with liquids.

The vessels to be filled are inverted and placed with their open ends below the surface in a container partially filled with liquid. A lid is placed on the container and a pump operated to create a vacuum inside so drawing all or nearly all of the air out of the vessels to be filled. Air is then admitted to the container forcing liquid into the vessels. The liquid may be supplied to the evacuation chamber by a measuring pump so that the quantity of liquid placed in the cans can be determined.

It is claimed that vessels with small orifices may be filled completely, cleanly and without waste while it is unnecessary to have vessels empty to start with. E. R. B. S.

466. Process for Utilising Hydrocarbons in Internal-Combustion Engines and Apparatus Therefor. D. Balachowsky and P. Caire. U.S.P. 1,630,048 of 1927. Appl. July 1, 1924.

The process affords the possibility of utilising heavy hydrocarbons as fuel for any kind of internal-combustion engine, and is characterised in that the carburettor is combined with a device for continuously cracking the hydrocarbon, either by heat or catalysis. The oil is carburetted in the usual way, preheated by the exhaust gases from the engine and then passed through a chamber packed with plates or wires of catalytic material; *e.g.*, copper, nickel, etc., the latter being heated electrically or by means of a burner. The cracked products then enter the cylinder, where they are fired. The engine is started on petrol, a second carburettor being installed for this purpose. H. G. S.

See also Abstracts Nos. 417, 425, 428, 430 and 440, and also those under the heading of Oilfield Technology.

Antidetonation.

467. Detonation. Some Practical Considerations. W. A. Whatmough. (*Automobile Engineer*, June, 1927.)

In a resumé of papers by other workers, details and photographs are given showing the "wind thrust" of one flame front upon another, during explosion in a closed vessel of a gaseous mixture by dual ignition. In a spherical vessel, if the ignition is not central the rate of travel of the flame is seen to be faster on the open side. Photographs show the extreme sensitiveness of flame spread to turbulence and to violent ignition. Successive photographs at intervals of 9.6 milli-seconds are shown where the vessel is hour-glass shaped, the flame spreads through the neck as a high speed jet, causing violent turbulence in the second charge. "Uniform, turbulent and detonative propagation of flame merge into one another as the rate of combustion increases." W. N. H.

See also Abstract No. 464.

Cracking.

469. Hydrogenation of Organic Compounds. E. J. Lush. *Ind. Chem.*, 1927, 309–313.

The article is a brief review of the hydrogenation of organic compounds other than vegetable oils, a short bibliography being appended. The paper deals with catalyst supports, endothermic nature of reactions, reversibility and selectivity of hydrogenation and catalyst poisons, and then refers to the hydrogenation of carbon bisulphide, benzene, nitrobenzene, phenols and cresols, naphthalene, carbon monoxide, coal, wood, vegetable and petroleum

products. The hydrogenation of the last-named may be carried out with the object of removing sulphur, cracking, saturation of double bonds in cracked spirit and kerosine, or the bleaching of lubricating oils. Crude lubricating oil bases containing up to 2 per cent. of sulphur have been rendered practically odourless by the writer, the catalyst remaining active after continuous use for several weeks. Hydrogenation removes a very high percentage of the colour of spindle oils and has the advantage over acid refining that the bleaching is carried out without loss of material. H. G. S.

470. Process for Making Motor Fuel. R. Cross. U.S.P. 1,631,401, 1927. Appl. Sept. 12, 1925.

The process consists in extracting the aromatic and sulphur compounds from oils by means of liquid sulphur dioxide, removing the latter and cracking the extract in the liquid phase. The resulting cracked spirit is rich in aromatic hydrocarbons, and therefore possesses valuable anti-detonating properties. H. G. S.

471. Preparing Catalytically, Alcohols and Other Oxygenated Organic Compounds. L. Casale. E.P. 252,713. June, 1927. Appl., May 25, 1926.

In this process, hydrogen or hydrogen and gaseous hydrocarbons react with carbon monoxide or dioxide, in the presence of a catalyst under suitable conditions of temperature and pressure, to form alcohols or a mixture of compounds, principally alcohols, aldehydes, ketones, and organic acids, which may be used as solvents or fuel either as obtained or with a simple and inexpensive treatment. The apparatus consists of a cylindrical vessel constructed to withstand the pressure necessary. Within the cylinder are three concentric tubes, the innermost containing an electric heating element, the annular space between this and the next tube contains the catalyst and the other two annular spaces constitute a heat exchanger; the hot products leaving the apparatus via the inner, and the cold gases entering through the outermost annular space, thence down the central tube. In this manner the gases are brought up to the reaction temperature before coming into contact with the catalyst, the catalyst is easily changed, uniformity of temperature in the catalytic region and large recovery of heat is obtained, moreover, the temperature of the pressure cylinder is kept low. R. P.

472. An Improved Process for Converting High-boiling Hydrocarbons which have been freed from the Substances Soluble in Liquid Sulphurous Acid, into Low-boiling Hydrocarbons by means of Aluminium Chloride. A.G. für Chem. Ind. m.b.H. E.P. (*a*) 271,042, 1927; (*b*) 272,433, 1927.

(*a*) The basis of the process lies in the fact that heavy oils refined by means of liquid sulphur dioxide contain a group of hydrocarbons, which split up readily under the catalytic action of aluminium chloride, and a group in which this splitting takes place more slowly. The refined oil is therefore cracked by the use of only 2 per cent. of catalyst and the spirit distilled off. The residue may constitute a primary material for the preparation of Diesel, transformer, turbine or white oils or it may be cracked by the use of about 6 per cent. of aluminium chloride.

(*b*) After the preliminary treatment with 2 per cent. of catalyst and removal of light products, the residue is extracted with sulphur dioxide and retreated with a further 2 per cent. of aluminium chloride, the process being repeated as often as desired. H. G. S.

473. Improved Process for Cracking Hydrocarbon Oils. Chemical Research Syndicate, Ltd. E.P. 253,562, 1926.

The objects of the invention are to crack oils in the vapour phase and to precipitate the carbon which is formed in a predetermined part of the process. The oil is vaporised, cracked in a converter in the presence of steam and a metallic oxide and then suddenly cooled to about 315° C. by contact with incoming cold stock. The whole of the carbon produced in the operation is deposited at the cooling stage and means are provided for its collection and removal. H. G. S.

474. Production of Paraffin-hydrocarbons with more than Carbon Atom. F. Fischer and H. Tropsch. E.P. 255,818. June 27, 1927. Conv. date, June 21, 1925.

Oxides of carbon and hydrogen are passed over catalysts at atmospheric pressures. Temperatures are maintained about 80–100° C. below that at which the main reaction product is methane. Higher homologues of methane are formed. Nickel is excluded as a suitable catalyst; a mixture of zinc oxide and finely divided iron is quoted as a typical case. W. N. H.

475. Producing Light Hydrocarbon Liquids. E. C. Herthel. U.S.P. 1,632,967, June, 1927. Appl., April 4, 1925.

The gasoline produced by cracking heavy oils is usually deficient in light easily vaporizable fractions and the common method of rectifying this fault is to blend cracked spirit with casing head or natural gasoline.

This process provides an improved method of producing the desired light fractions, without the danger due to the high vapour pressure and inflammability of casing head gasoline, and without the heavy losses due to evaporation whilst handling such light spirit.

In the process, heavy oils, such as gas oil or gas oil containing a high wax-content, are cracked to a limited extent. By mild cracking the excessive production of gas and coke is avoided. The vapours are subjected to a refluxing operation and brought into direct contact with the fresh charging stock at a rate of more than 190 per cent. of the rate at which distillate is taken off. Also, the rate of feeding and that rate at which oil is withdrawn from the still, are regulated to maintain the amount of distillate at not more than 30 per cent. of the total charge, including the fresh oil supplied.

R. P.

476. Cracking of Hydrocarbons. E. C. Herthel and H. L. Pelzer. U.S.P. 1,634,666, July, 1927. Appl., April 8, 1924.

According to this invention the deposition of coke on the heated surfaces of pressure stills is prevented or greatly reduced. The process consists of charging a still with oil, circulating the oil from the bottom and back into the upper part of the still.

Within the shell of the still a bed of fullers earth, 10-in. to 18 in. deep, is supported about 2 ft. from the bottom, in such a manner that the circulating oil must pass through the fullers earth. Means are provided for removal of cracked vapours, for discharging part of the heavy tar and for introduction of fresh oil along with reflux. The heavy tar is drawn from above the fullers earth and the fresh oil introduced beneath.

By proper regulation of the feed and draw-off the pitch-content of the charge is maintained well below saturation point and is mostly held in solution, whilst the fullers earth removes the asphaltic matter which most readily decomposes to form coke. At the same time desulphurisation takes place After a run of 173 hrs. with fullers earth, soft coke removed from the heating tubes amounted to 167 lbs. whilst without the fullers earth 250 lbs. were obtained in 29 hrs. R. P.

477. Production of Liquid Hydrocarbons from Heavy Organic Materials. G. Patart. E.P. 249,519, June, 1927. Appl., Mar. 5, 1926.

This process combines the synthesis of methanol with cracking of mineral oils, or decomposition of coal or other carbonaceous materials. The main synthetic action consists in the manufacture of hydrocarbons and oxygenated derivatives by catalytic hydrogenation of carbon dioxide under high pressure and at high temperature. The gases are circulated in a closed circuit and those gases which have not reacted are returned to the catalysing chamber. Between the last catalysing chamber and the condenser one or more digestors are placed to contain coal (or other carbonaceous material). The gases leaving the catalysis chamber pass upwardly through the digestor. After 3 hrs. treatment the coal is reduced to 60 per cent. of its original weight, has become porous, and of a brilliant black appearance, whilst the condensed liquid contains an increased amount of volatile products.

In the treatment of wood fragments the hot gases are passed upwardly as before, but at the same time a proportion of the distillate is allowed to flow downwards through the charge.

In addition to undecomposed methanol, pine oil, acetone isopropyl alcohol and acetic acid are extracted from the wood.

Mineral oils may also be treated in the digestor by bubbling the hot gases through the oil, the temperature being raised above cracking conditions. Thus the production of light oils is greatly increased. R. P.

478. Improvements in the Manufacture and Production of Liquid and Other Hydrocarbons and Derivatives Thereof from Coal and other Like Materials. I. G. Farbenindustrie A.-G. E.P. (*a*) 247,582, 1926; (*b*) 247,583, 1926; (*c*) 247,584, 1926; (*d*) 272, 829, 1926.

(*a*) This invention relates to the transformation of solid carbonaceous bodies like coal, lignite, peat, etc., into liquid products by hydrogenation at elevated temperatures and under pressures exceeding 50 atms., the characteristic feature being the use of combined nitrogen as a catalyst. The nitrogen may be added to the reducing gases in the form of ammonia, or to the coal as ammonium sulphide or as silicon or titanium nitrides or other nitrides which are stable to the action of water. Alternatively, free nitrogen may be introduced with the reducing gases and ammonia produced in the reaction vessel by the action of catalysts such as iron activated by the addition of alkalis in mixture with alumina, activated barium compounds or a carbide of a rare earth. The reducing gases may consist of ammonia, but are preferably composed of hydrogen or the latter admixed with carbon monoxide, sulphuretted hydrogen, methane or steam. The hydrogen may be produced in the reaction vessel by the action of steam on hydrocarbons, coal, carbon monoxide, or the like. As an example, dried lignite, either alone or mixed to a paste with a liquid medium, is introduced continuously into a high pressure vessel heated to about 500° C. and is acted upon by a stream of hydrogen containing one per cent. of gaseous ammonia under a pressure of 100 amts. On cooling the gases leaving the apparatus, a thin oil containing only small amounts of phenols is obtained. When 10 parts by weight of coal are acted upon by four parts by weight of hydrogen, the coal is transformed into liquid products in a yield of 80 per cent. or more.

(*b*) Catalysts containing molybdenum or compounds of molybdenum, e.g., molybdenum sulphide, molybdic acid or ammonium molybdate are employed to accelerate the hydrogenation of coal and the like. The above

substances may be used in mixture with other catalysts or inert materials, such as iron, cobalt, aluminium hydroxide, calcium carbonate, etc., and supports of clay or the like may be employed simultaneously.

(*c*) Combined sulphur is claimed as a catalyst, either in the form of one or several sulphides alone or mixed with metals, metalloids, oxides, hydroxides, carbonates, etc. The sulphides of the heavy metals, especially those of the iron group, are particularly efficient.

(*d*) When, in hydrogenating coal and the like, both nitrogen compounds and other catalysts are employed, the latter may be placed in a separate compartment, so that only the vapours of the resulting products are passed thereover.

H. G. S.

479. Improvements in the Manufacture and Production of Hydrocarbons and Derivatives Thereof from Products of the Distillation or Extraction of Coal and Other Like. I. G. Farbenindustrie A.G. E.P. (*a*) 247,585, 1926; (*b*) 247,586, 1926; (*c*) 247,587, 1926.

(*a*) This invention is a modification of E.P. 247,584 (see preceding abstract) applied to tars and other coal products. In the example quoted, pressed precipitated cobalt sulphide is used in the hydrogenation of crude cresylic acid at 150 atmrs. pressure and 400° to 500° C. Considerable reduction of phenols to hydrocarbons is claimed.

(*b*) A modification of E.P. 247,583 (preceding abstract) applied to the treatment of the products of distillation or extraction of coal, lignite, peat, wood, etc., or of tar-like products of animal origin. The molybdenum may be carried on supports such as fireclay or in mixture with materials which increase the hardness and durability of the contact mass. The latter possess excellent resistance to contact poisons, especially to sulphur and other impurities. The reaction is not affected by the presence of water. In the example, brown coal producer tar is passed together with nitrogen and hydrogen at about 500° C. under a pressure of 200 atmrs. over a contact mass prepared by pressing molybdic acid with an addition of 20 per cent. of aluminium hydroxide so strongly as to produce lumps of the catalyst in order to facilitate the passage of the gas. A thin nearly colourless product of 0·83 specific gravity consisting of hydrocarbons free from phenols is produced and no coke or asphalt and the like and only a small quantity of gaseous products.

(*c*) This process is a modification of E.P. 247,582 (preceding abstract).

H. G. S.

480. Improvements in the Manufacture and Production of Hydrocarbons and Derivatives Thereof from Natural Oils and Other Bitumens. I. G. Farbenindustrie A.-G. E.P. (*a*) 249,493, 1926; (*b*) 250,948, 1926.

(*a*) A modification of E.P. 247,584 consisting in the employment, instead of solid carbonaceous materials, of mineral oils and other bitumens or distillation or extraction products obtained thereform.

(*b*) A modification of E.P. 247,582.

H. G. S.

481.—Improvements in the Manufacture and Production of Liquid or Other Hydrocarbons and Derivatives Thereof from Coal, Tars, Mineral Oils and Other Like Materials. I. G. Farbenindustrie A.-G. E.P. 251,264, 1926.

Catalysts containing tungsten or chromium or their compounds may be used in the hydrogenation of coal, tars, mineral oils, etc., instead of molybdenum and its compounds. Tungsten sulphide, tungstic acid, chromium hydroxide or oxide and chromic acid may be employed, either alone or mixed with other catalysts or activating materials, e.g., molybdenum, cobalt, nickel,

iron, copper, silver, aluminium hydroxide, magnesia, zinc oxide, potassium carbonate, etc. As an example, crude cresols from coal tar are passed with hydrogen over tungstic acid at from about 500° to 550° C. under a pressure of 200 atms. They are rapidly and completely transformed into aromatic and hydroaromatic hydrocarbons. H. G. S.

482. Destructive Hydrogenation of Coal, Tar, Mineral Oils, etc. I. G. Farbenindustrie A.-G. E.P. 254,713. June, 1927 (Appl. June 28, 1926.)

The manufacture of valuable hydrocarbons and their derivatives by treatment of carbonaceous materials with hydrogen under high pressure can be carried out with such gases as are obtained by decomposing gases or vapours containing hydrocarbons by means of oxygen or gases richer in oxygen than air, in the presence of catalysts so that the hydrocarbons are converted mainly with carbon monoxide and hydrogen then converting the monoxide into carbon dioxide and hydrogen by means of water vapour. The catalysts may be solid, such as magnesia with nickel precipitated thereon, or liquid, such as molten iron or alloys. Preferably the gas mixture rich in hydrocarbons resulting from the process is employed, as the initial gas for decomposition into carbon-dioxide and hydrogen, after removal of valuable products such as the higher hydrocarbons by cooling to low temperatures or by absorbtion. R. P.

483. Manufacture of Active Adsorbent and Catalytic Masses. I. G. Fabenindustrie A.-G. E.P. 255,904, July 7, 1927. Conv. date and July 7, 1925.

The support for the catalyst is prepared in colloidal condition and is mixed with the catalyst or with the substance subsequently to be converted into catalyst such as a solution of a salt. The mixture is allowed to set to a jelly and is dried at any desired temperature above 100° C. W. N. H.

484. Improvements in Catalytic Dehydrogenations. I. G. Farbenindustrie A.-G. E.P. 262,120, 1926.

The process of catalytic dehydrogenation consists in the employment, as catalysts, of sulphides of the heavy metals, alone or in mixture and with or without supports. Zinc and cadmium sulphides are specifically mentioned. Thus a 92 per cent. yield of isobutyraldehyde is obtained by passing the vapours of isobutyl alcohol over zinc sulphide upon a carrier of pumice stone at 460° C. Isoamyl alcohol gives isovaleraldehyde with zinc sulphide at 430° C. whilst isobutyl alcohol over cadmium sulphide on pumice stone at 540° C. gives 75 per cent. or more of isobutyraldehyde. H. G. S.

485. Improvements in or Relating to Apparatus for the Hydrogenation of Liquids. G. R. Schueler. E.P. 273,045, 1926.

The invention relates to that type of apparatus for hydrogenating liquids in which the catalyst is metallic and is packed in one or more cages placed in the hydrogenating vessel. The cages are provided with centrally disposed perforated tubes or coils, preferably of nickel, the hydrogen being caused to flow through the tubes and perforations into the liquid to be treated. H. G. S.

486. Production of Petrol. F. Tinker. U.S.P. 1,632,011, June, 1927 (Appl. September 25, 1922.)

The method enables a higher yield of motor spirit to be obtained from a system containing the ordinary elements of a topping or cracking plant consisting essentially of a pipe still, separating drum, fractionating column, and condenser, connected in series.

The reflux from the dephlegmator is passed to another still and superheater, wherein the reflux is cracked, and the vapours produced are returned into the dephlegmator, or may be returned to the separating drum. There is thus a continuous recycling and recracking of the reflux separately from the raw feed. The extra still and superheater may be added to any type of cracking plant where a dephlegmator is in use. Using a loop system as above has the advantage that the volume of flow per unit of time through the loop can be much greater than in the main part of the system, consequently carbonisation can be reduced to a minimum, but owing to the greater volume of vapour and heat delivered into the column it is necessary to make provision for cooling the vapour in any convenient manner. R. P.

See also Abstracts Nos. 431, 462 and 415.

Oilfield Technology.

487. Drilling and Casing Rules Adopted for Operations in Montana. *Oil Age*. July, 1927.

A conductor string of casing will be set at sufficient depth below the surface to exclude shallow water and act as a tie in case an unexpected flow of oil, gas or water should be encountered while drilling.

All water to be confined to the stratum in which it occurs and test made for water shut off before drilling ahead.

All showings of oil or gas to be thoroughly tested for their commercial possibilities in a dry hole before drilling ahead. Each showing to be properly protected to prevent migration.

Waste of or damage to all other minerals drilled through to be prevented where possible.

The Sunburst sand is to be thoroughly tested for commercial oil or gas possibilities and actual open flow volume and open flow rock pressure tests are to be recorded.

If oil or gas is to be produced from the Sunburst sand, casing will be set on top of the sand. This string of casing will be "mudded in" by circulation completely filling the annular space between the outside of the casing and the wall of the hole with mud from the shoe to the surface.

In the event of the well being drilled to the Ellis oil sand and gas from the Sunburst sand is taken through a Bradenhead, the casing will be set and mudded in on top of the Sunburst sand as above and in addition a string of casing will be set in the "black lime" at a sufficient distance above the Ellis oil sand so that the latter can be shot without danger of damaging the casing The casing shut off is to be tested to determine whether or not the gas from the Sunburst sand has been excluded.

If only oil from the Ellis sand is to be produced in the well, the Sunburst sand will be protected by setting and mudding in the casing as above, in the black lime at a sufficient distance above the Ellis sand to permit shooting of the Ellis sand without danger of damaging the casing. A. R. S.

488. Principles of the Air and Gas Lift. P. F. Shaw. *Oil and Gas J.* June 16, 1927.

The theoretical side of the air lift pump is given in simple form: the practical side is discussed exhaustively. The terms in use when dealing with the subject are explained, and numerous tables are given embodying the various factors affecting the pump operation. These tables include the work done in compressing a gas, the volume of gas at various pressures necessary to raise one gallon of water, relation between friction loss for air and for gases of various densities, friction loss for air, and a number of tables giving

data for wells fitted with air-lift pumps or flowing under the pressure of their own gas. Sample calculations for obtaining figures for efficiency, submergence, capacity of compressor etc., are given. The author briefly describes design of the pumps. P. D.

489. Hubbard Oil Head Method of Pumping Deep Wells Exceeding 3,500 Feet. *Oil Field Engineering.* May, 1927. 57.

The article describes a new type of apparatus consisting of reciprocating machinery at the surface, a string of sucker rods of varying diameter, a reciprocating working barrel wherein the plunger valve is automatically opened on the down stroke and a gas separating device set below the working barrel.

The actuating mechanism called the oil head is located over the well on the derrick floor, but may be disconnected and swung aside very rapidly when desired. The oil head consists of two cylinders having pistons placed vertically one above the other with a common piston rod, the extension of which is directly coupled to the sucker rods. The upper ends of both cylinders are open to the atmosphere while fluid pressure may be applied below the pistons. The upper cylinder is connected by a pipe with the bottom of a closed vessel called the balance chamber, this is suitably proportioned and is partly full of fluid with the remaining space occupied by air under pressure. The pressure is such that with the pistons at the top of their stroke the upward force on the piston in the upper cylinder is nearly equal to the weight of the sucker rods. The lower cylinder and piston supply the power for raising oil and are driven by pressure obtained from a fluid pump. A valve actuated by the rise and fall of the pistons puts the lower side of the working cylinder in connection with one of two chambers. One of these chambers contains fluid and air under pressure and receives fluid from the discharge side of the driving pump, this being known as the pressure chamber, while the other chamber, coupled to the suction of the pump and called the receiving chamber, contains air and fluid at very low pressure.

When the pistons reach the top of their stroke the valve opens to connect the working cylinder with the receiving chamber. The pressure on the balance piston is insufficient to support the weight of the rods, which commence to fall rapidly, driving fluid into the balance chamber and receiving chamber. Before reaching the bottom of their stroke, which is about ten feet, the pressure in both receiving and balance chamber will have been raised, due to the fluid driven into them, thus checking the momentum of the rods. On reaching the lowest point of travel the valve changes over and fluid from the pressure chamber is allowed to act on the working piston. This, aided by the increased pressure in the balance chamber, produces a rapid upward acceleration of pistons and sucker rods, which is again checked before the top of the stroke, owing to the reduced pressure caused by the rush of oil from the two vessels. This cycle is repeated and gives a very smooth action of the rods, while by suitable adjustment it is possible to produce a different piston speed on the down-stroke from that on the up-stroke. Used under identical conditions the smooth operation of the oil head has proved an immense improvement over the standard beam pumper, both as regards rod breakage and the number of equal strokes necessary to raise a given quantity of oil.

For use with the oil head, where the actual dead weight is of less importance than with a beam, Hubbard's sucker rods have proved very successful. These rods are of progressively varying diameters and reduce the stretch due to their own weight and also that due to acceleration, oil weight and friction, thus reducing rod breakage to a minimum. The extra weight is balanced by an increase of pressure in the balance chamber of the oil head.

To overcome loss in efficiency due to the presence of gas the Hubbard oil pump and Hubbard gas separator may be used with advantage. The oil pump has a delivery valve which is opened on the down stroke by pressure applied to a piston in a cylinder through a friction operated pilot valve, thus allowing all gas to escape from under the plunger. The gas separator uses a down pipe and standing valve contained in an extension of the oil tubing and so draws oil from the densest part. The design allows the standing valve to be drawn to the surface when the plunger is removed. E. R. B. S.

See also Abstracts Nos. 421 and 463.

Petroleum Geology.

490. Natural Gas Development in California. L. C. Decius. *Oil and Gas J.* June 16, 1927, pp G. 75-G. 85.

In consequence of the natural features of California, the natural gas there produced must be marketed within the State as far as can be done economically. Pipe-line transportation of the gas is out of the question outside the limits of the State. The State is divisible into five main physiographic provinces :—

(1) The Sierra Nevada Mountains bordering the east of the State.

(2) The Coast Ranges, all along the Pacific Coast from Oregon to Mexico.

(3) The Great Valley in the centre between Tehama County on the north and Kern County on the south (Sacramento and San Joaquin valleys).

(4) The great expanse of Desert region, south-east of the State.

(5) The Los Angeles Basin.

In respect to gas production, No. 5 is the greatest unit.

Gas-bearing structures have been formed where the Tertiary sediments are folded into favourable structures for accumulation on the rims of the great valleys and coastal plains. There are but a few exceptions to this general rule.

The gas occurs throughout the entire Tertiary system. (Eocene, Oligocene, Miocene and Pliocene).

The oil and gas in the upper cretaceous north of Coalinga may here be mentioned, which is of only small consequence.

The Miocene rocks are the source of probably more than 90 per cent. of the production of the entire State.

It is of interest to note the comparative absence of limestones in the above Tertiary formations. The Miocene is composed of great thicknesses of organic shales, in part silicious and in part occurring as chalk-like deposits of "Diatomite," as well as great thicknesses of sandstone.

Thicknesses : Eocene, 9,000 ft. ; Oligocene, 4,000 ft. ; Miocene, 9,000 ft. ; Pliocene, 21,000 ft.

Outcrops of oil-bearing sands led to the discovery in California ; in these at first pits and tunnels were dug into which the seepage oil drained.

The Miocene series consists in its lower part of a medium to coarse sandstone, with distinct fossil fauna (Vaqueros horizon). This affords an excellent reservoir for oil and gas accumulation.

The Temblor group resembles this closely.

The "Monterey shale" (middle Miocene) is by far the most important economically of any local series in California as a source of oil and gas. It is an extremely rich organic shale, maximum thickness 9,000 ft., and the main source of at least 90 per cent. of Californian oil and gas. The Santa Margarita formation (upper Miocene) may be either sand or shale.

The determination of certain horizons at a given depth has been effected by microscopic work.

The simplicity of determining structures in California from surface outcrops over the greater portion of the oil-bearing regions is shown in a photograph of the Ventura Anticline (p. G.75).

Closed anticlines are the most important structures; faulted monoclines are of secondary importance; and open monoclines have also afforded oil and gas of considerable importance. Faults have occasioned accumulations in the Inglewood Field in the Los Angeles Coastal plan; also at McKittrick and Brea Olinda. In the case of the open monoclines an asphaltic residue has sealed most of the gas and oil content of subjacent sand, as in the West Side Coalenga and the Midway Sunset Fields in San Joaquin Valley.

About twenty years ago engineers and geologists of California started systematic work on the correlation of sub-surface data, which has been of the greatest service. To-day core and drill samples and microscopic fossil evidence from drill samples are depended on for fixed points of demarcation between certain rock horizons.

It is pointed out (under "Terminology") that the fluid occupying the pore space of any of the sedimentary rocks is a secondary matter and is not subjected to the rock pressure itself, but only to its own hydrostatic head. The oil and gas in the process of generation is moving towards the point of least pressure, and in doing so it naturally moves upward in the column until it may reach strata of impervious material, through which it does not easily penetrate. The uppermost point to which the globules of gas will move along the bedding planes is near the axis of some anticline or upper member of some favourable structure and under an impervious clay or shale material.

In migrating, the uppermost accumulation will have suffered the greatest oxidation, and so we find the highest gravity oil in the lowest horizons, where they have been subjected to least oxidation. Whether the gas-pressure is considerably higher in the crest of the anticline or not is a debatable question.

Plate II shows that the amount of gas per barrel of oil produced by wells that have penetrated near the crest of the anticline is far greater in proportion than that produced per barrel of oil by wells drilled down the flanks of the anticline. The author is of opinion that this gas-oil ratio condition exists partly owing to the fact that pressures are higher near the crest of the anticline, and partly due to improper tubing of the wells.

The future outlook of natural gas consumption in California has a brighter outlook from an economical viewpoint. Many gas lines are already constructed and more are under construction at this time. New fields to be found in this State are almost certain to be located within reasonable distances of the already existing gas pipe lines.

It is believed that a far greater proportion of the gas to be found in future fields will be used as fuel for industrial and domestic purposes than has been in the past.

There are no developed gas fields in California producing gas alone. Technical men are devoting much time and work toward the conservation of California gas. They realise that the lower the gas-oil ratio of a given well can be made, the greater the production that can be expected from this well under flowing methods. Improved tubing methods are now employed.

J. E. M. H.

491. The Present Status of the Carbon-Ratio Theory. George Edwin Dorsey. *Bull. of American Assoc. of Petr. Geologists.* May, 1927.

The essence of the carbon-ratio theory is the assumption of a causal connection between stages of metamorphism and the occurrences of gas and oil. Many geologists are of the opinion that the observations of White, Fuller, Russell, Moulton, and other investigators constitute proof of a causal assumption in pointing out that there is a definite relationship between degrees of

alteration, using the fixed carbon of coal as a pyrometer, and oil and gas occurrences. Other geologists, although not questioning the observational data indicating the relationship, are led by the serious inconsistencies in the application of the theory, in so far as its causal feature is concerned, to believe no causal connection has been proved. The inconsistencies are :—(1) The problem of residues ; (2) the occurrences of oil of lower grade in older beds below higher grade oil in younger beds ; and (3) the presence of areas producing only dry gas in quantity in the same zone of alteration with areas producing oil, and oil and gas. The writer seeks in this discussion to compare the evidence regarded as proof of the theory with these inconsistencies. The conclusion is reached that so far as the causal part of the theory is concerned, it has the same status it had when the theory was first enunciated—an unproved assumption.

J. E. M. H.

492. Oil and Gas Possibilities of Palestine and Sinai. By D. F. Higgins. (*Bull. of American Assoc. of Petroleum Geologists.* May, 1927.

In the February number of this Bulletin F. Julius Fohs presents the results of geologic research and reading by himself and W. H. Foster under the above heading. This is a note upon that paper.

The geologic column is in the main correct, or as nearly so as it can be in a country of rocks so lithologically similar, so sparse in fossils, and so badly faulted as Palestine.

Igneous activity has been very pronounced at a comparatively late date (Pliocene or later).

The Plain of Esdradon is occupied by great surface flows of basalt. The whole aspect of the Jerusalem anticline is that of a highly faulted area bulged up by igneous activity and irregularly settled down with the cooling of a magma which has reached the surface here and there.

No source beds adequate to give reasonable hopes for commercial reservoirs have been found to date, in Sinai, Palestine, or Syria. Good geologists of well-known American companies have "turned down" what is supposed to be the most favourable area in Palestine—for reasons which they thought entirely adequate.

The writer advises against exploratory drilling for six reasons :—

(1) The ulterior interest of the Mandatory Power in oil-prospecting in Palestine. (2) The general and high degree of faulting of the terrain. (3) Igneous activity at and near the surface. (4) Lack of adequate source beds. (5) Unreliability of results by some of the early workers. And (6) the fact that the country has been "turned down" by competent oil men.

J. E. M. H.

493. The Relation of Structure to Production in Fine Oil and Gas Fields of the Kentucky Eastern Coal Field. L. E. Fiske. *Bull. of American Assoc. of Petr. Geol.* May, 1927.

The structure and related production are described in five oil and gas fields of the eastern coal field of Kentucky—namely :—(1) The Lee-Estill-Power oil field ; (2) the Compton oil field ; (3) the Owsley County gas field ; (4) the Clay County gas field ; and (5) the Elliott Co. oil field. The producing beds are Pennsylvanian, Mississippian, Devonian, and Silurian in age, the next important being the Corniferous limestone of the Devonian. The major structural features of the general area are the Cincinnati Arch and Paint Creek Uplift, whose axes extend north and south, and the Pine Mountain and the Irvine Paint Creek faults and uplifts, whose axes extend east and west. These two systems of folding are dominant features in Eastern Kentucky. The Cincinnati Arch has had a marked effect on both structure and

stratigraphy. It was probably a positive element throughout the time of deposition of the formations in these fields. Formations increase in thickness with distance from the Arch, and minor folds parallel the arch. Subsequent folding and faulting with east and west axes were the result of pressure from the south. Production is related to structure only in a general way; the porosity of the sands and limestones seems to be the controlling factor for oil and gas accumulation. Several wells have been drilled in the Elliott County oil field proving the crest of the main fold to be dry, probably because of unfavourable sand conditions. An interesting feature of the map of the eastern coal field is the relation of the oil and gas production and the isocarbs to the major uplifts and faults. The Irvine sand pools, which produce 60 per cent. of the oil in the State, lie along the flank of the Irvine-Paint Creek uplift, paralleling the Irvine-Paint Creek fault. The Wier pools, which produce 30 per cent. of the State's oil, lie along the axis of the Paint Creek uplift. This close relation of production to uplift bears out the theory that oil was formed during, and as a result of folding rather than having been formed prior to the fold and having subsequently migrated into it. Folding seems essential to oil accumulation in Eastern Kentucky, but the degree of folding must not pass beyond a certain point or the hydrocarbons will be changed to gas. The most favourable formations for producing oil are stratigraphically high, geologically young, and moderately folded. The probability of finding many new oil fields of importance is not large. J. E. M. H.

494. Geology of the Appalachian Territory. J. French Robinson. *Oil and Gas J.* June 16, 1927. Pp. G.12—G.27.

The purpose of this article is to give the reader a general picture and familiarise him with a few of the most important phases of the geology of the great Appalachian oil and gas field. This field includes all districts east of Central Ohio, and north-east of Central Alabama that are producing oil and gas—*e.g.*, New York, Pennsylvania, West Virginia, and a portion of Ohio, Kentucky, Tennessee and Alabama.

This area still produces about 27,000,000 barrels of oil and 342,000,000,000 cubic ft. of natural gas annually. This represents rather less than 30 per cent. of the U.S.A. production of natural gas and 4 per cent. of their petroleum.

The gas and oil obtained have been of high grade and free from objectionable impurities.

The field lies just west of the Appalachian Mountain system. Oil and gas are usually found confined in the pore space of sandstone and conglomerates or limestones. Some gas has been found in shale deposits.

Surface indications are not numerous.

In general terms it would seem that oil production occurs when the "carbon ratio" (percentage of carbon in pure coal after the water and ash have been eliminated) in the surface coals does not exceed 60, and gas production when the ratio does not exceed 70.

Until 1875 Pennsylvania produced practically all the petroleum in the U.S.A. and 88 per cent. of the world production.

The Appalachian oil and gas field reached its maximum annual production of natural gas in 1917 with a total of 522,200,000,000 cubic ft. The oil production for the same district reached its maximum in 1900, with 36,300,000 barrels.

Production in this field is obtained from many geological horizons, including those of the Carboniferous, Devonian, Silurian, Ordivician and Cambrian systems. The pools or fields generally occur in the axes or flanks of anticlines or small terraces or other structural features associated with them, and in water-free synclines.

The Appalachian oil and gas field is a great geo-syncline that extends from New York State to Alabama. The lowest point structurally in the field is near Wileyville, Wetzel County, West Virginia. Other foldings occur upon the major fold, Burning Springs Volcano, Eureka anticline, the Wick anticline, Arches Fork, Murryaville, Warfield, Chestnut Ridge and Laurel Ridge anticlines.

Nearly all the folds extend in a general N.E. and S.W. direction, paralleling the Allegheny front.

Structure affords a condition whereby segregation of water, oil and gas takes place, and must therefore be worked in detail over territory to be operated upon. Many maps have been published by the States and by the U.S. Geological Survey.

The paper then gives (in Fig. 5) the detail structure map of sundry districts, and (in F. 6) the elevation of the Clinton sand below sea-level (monoclinal structure). Figs. 7, 8, and 9 give structures of other areas.

Faults play a small part in the production of oil and gas in the Appalachian field, as there are very few except in parts of Kentucky and Tennessee.

The enormous thickening of certain horizons must be noted, especially going from Central Ohio towards the south-east. Fig. 10 shows this.

Details are next given of the reservoir rocks (Table No. I) which are, generally speaking, well cemented fine to coarse grain silicious or calcareous stone. It has been stated that the sands vary in porosity from 10 to 30 per cent. Table No. II gives a summary of the deep drilling which has been done in this field; and other figures show structural relations between various wells.

Reviving old oil fields by water, air, or gas pressure is attracting considerable attention at present in this field. It is believed that from 20 to 40 per cent. of the original amount of oil in the oil-sand can be extracted by the present flowing and pumping methods.

The oil and gas production is gradually decreasing each year. The Cambridge gas fields, which is producing from lenses in the corniferous or Niagara lime, is one of the most recent gas and oil developments. Some of these wells have an initial volume of about 25 million cubic feet per day; others are showing for good oil wells.

The oil wells in the Appalachian field will average less than a barrel production of oil per day, and the gas wells will average hardly 20,000 cubic ft. of gas per day.

Numerous maps, and sections, and tables illustrate the subject-matter of this paper. J. E. M. H.

Coal and Shale.

495. Distillation of Tar. J. S. Morgan and D. Rider. U.S.P. 1,635,896. July 12, 1927.

The chief difficulties in the distillation of tar occur in the early and final stages. At first, the contained water causes frothing, and in the final stages, uniform and sufficient heating is made difficult owing to the high viscosity and poor conductivity of the oil.

These difficulties are obviated by the process which is described in this patent. The tar is fed under the surface of molten lead, the latter being maintained at a temperature sufficient to vaporise the more volatile constituents. The residue from this distillation is a semi-pitch containing the greater part of the anthracine present in the tar. The semi-pitch is withdrawn from the surface of the metal and caused to meet a jet of super-heated steam, so that it is broken up into spray and gives up its anthracene to the steam. W. H. T.

See also Abstracts Nos. 420, 477, 478, 479, 481 and 428.

Abstracts.

Arranged by W. H. Thomas, A.R.S.M.

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General.

496. Changes in Patent Office (United States) Procedure. Harold L. Kauffmann. *Oil and Gas Journal*, 1927, **26** (14), 146–147.

As a result of the recommendations of the Committee set up in 1924, a number of important changes have been made in the procedure of the United States Patent Office. Among these are the following:—

The filing fee has been increased by $1 for each claim over 20 and the final fee has also been increased by $1 for each claim over 20. This has been done in an endeavour to prevent patentees making an excessive number of claims in a single patent. Claims should not consist of mere reiteration of the same thing put in other words, but should contain material differences. It was not uncommon for applications to contain over 100 claims.

Amendments to applications must be made within six months instead of one year. Amendments may be made to correct an error or to avoid the reasons given for the rejection of an application.

When a case was forfeited by failure to pay the final fee within six months after allowance, it could be renewed by an interested party within two years after the notice of allowance. The original papers could be used, but a new filing fee was necessary. The time for exercising the right of renewal is now reduced to one year.

Notice of appeal from decisions of the Commissioner of Patents must be given within 40 days and a transcript of the record filed within 40 days thereafter. Appeals must be made within six months instead of one year.

Previously appeals outside the Patent Office could be made to the Court of Appeal and the party losing the decision could then file a bill of equity under Section 4915 of the revised statutes. Either course may now be followed, but not both.

No appeal can be made to the Supreme Court from the Court of Appeal, and there is no appeal to the Secretary of Commerce against the action of the Commissioner.

A person granted a patent has no grounds for appeal and the weight of authority is against a patentee appealing from an adverse decision in interference proceedings.

Any action amounting to a final refusal of a patent is regarded as a rejection and is appealable. The refusal to entertain an application, and

the requirement that an application be divided, are appealable. Only final decisions are appealable.

A refusal of a rehearing is not appealable, nor is a decision dissolving an interference. A decision can be appealed, but not the reasons for a decision.

In appeals for interference the court considers the question of priority and not patentability.

New rules have been established within the Patent Office in order to render improved service to patentees and to patent lawyers. G. S.

497. Definition of Petroleum Products under the (French) Law of 1919. *La Rev. Petrol*, May 14, 1927.

Gas Oil.—Dark brown in colour. Not more than 1 per cent. (by vol.) distilling below 275° C. (thermometer immersed—Luynes Bordas apparatus). Inflammability, Luchaire 50–110° C. Fluidity, Barbet, minimum of 300 divisions at 20° C. Not less than 5 per cent. (by vol.) removal by 66° H_2SO_4.

Fuel Oil.—Nearly black in colour. Not more than 10 per cent. (by vol.) distilling below 275° C. (thermometer immersed—Luynes Bordas apparatus). Inflammability, Luchaire 50–140° C. Not less than 25 per cent. (by vol.) removable by 66° H_2SO_4.

Road-Oil Residuum.—Black in colour. Not more than 2 per cent. (by vol.) distilling below 300° C. Not less than 9 per cent. (by vol.) removable by 66° H_2SO_4.

Petroleum Pitch.—Black in colour. Hard, semi-hard, semi-soft or semi-fluid. Softening point 100° C. or below.

Coke.—Black, solid, very light and devoid of ash.

Refined or Burning Oils, Gasolines, Lubricating and other Heavy Oils, Paraffin and Vaseline.—Specifications as applied under tariff regulations governing the importation of foreign goods. W. H. T.

498. The International Aspect of America's Over-Production. *Petr. Times*, 1927, **18** (448), 307–308.

Speaking at the opening of the third semi-annual conference of the American Petroleum Institute, Mr. E. W. Clark, the President, said that the present system of oil production was not of deliberate design but was an automatic development of conditions plus private commercial enterprise. He said that the oil markets of the world were being overstocked and over-supplied, and that competition for gallonage should cease where economic advantage left off and financial sacrifice began.

When drilling an oil pool in a hurry, it was learnt that the more wells drilled at the same time (1) the greater the increase in cost per barrel of total oil recovered; (2) the more gas pressure released, thus diminishing the ultimate total oil recovery; and (3) the more oil forced on an over-supplied market at an uneconomical price.

Often oil men exhibited a Ph.D. degree to prove their ability to co-operate work which should not be co-operated. He suggested that they should (1) seek the real meaning of industrial co-operation and practice it; (2) procure a copy of "The A.B.C.'s of Science in Oil Recovery," published by the Institute, read it and think hard; and (3) the industry should embrace the opportunity offered by the Federal Oil Conservation Board and with its aid work out a permanent policy regarding oil production. There was no doubt that the Government desired to help the industry with its problems.

It was necessary to take a world view and to think in terms of decades. Less than 20 years ago Russia produced more petrol in a year than the

United States, and before many years Russia would again become a first-class power in petroleum.

Venezuela has a potential production as large as that of the United States only a few years ago, and in Persia another factor in potential competition is found.

Since the war more Governmental energy has been devoted to seeking the world's resources of petroleum than to any other industry. The situation might well invoke serious thought and co-operation of both political and industrial statesmanship, and was vital to every power industry in the world.

To make fundamental changes involved innumerable problems and forced knowledge which could only be developed by scientific investigation and practical research. The units of industry should put all known scientific facts about production into the hands of the Institute, as a central body.

Mr. Clark had no solution to offer, but thought it might be necessary to introduce legislation to prohibit the escape of gas except during drilling, completing and testing a well. The reason was obvious. G. S.

See also Abstracts Nos. 539, 544, 584, 628, 629 and 630.

Chemistry of Petroleum.

499. Action of Silent Discharge in Olefines. Demjanov and Prianishnikov. *J. Russ. Phys. Chem. Soc.*, 1926, **58**, 462.

Under a potential of 12,000–13,000 volts, ethylene yielded a yellow, mobile oil d_4^{20} 0·8360, n_D^{17} 1·4580, average molecular weight 215, consisting of unsaturated hydrocarbons, from C_6H_{12} upwards, which reacted with bromine and dissolved in concentrated sulphuric acid, together with saturated compounds. Isobutylene gave a product of molecular weight 140, d_4^{19} 0·822, $n_D^{6\cdot5}$ 1·4730, containing chiefly the hydrocarbons C_9H_{18} and $C_{12}H_{24}$, with a fraction of b.p. 30–42°, consisting, probably, of the compound C_5H_{10}. W. H. T.

500. Catalytic Activity of Metallized Silica Gels. I. The Hydrogenation of Ethylene. V. N. Morris and L. H. Reyerson. *J. Phys. Chem.*, 1927, **31**, 1220.

The catalytic hydrogenation of ethylene by silica gels metallized with platinum, palladium and copper has been studied under various conditions. Platinized and palladized gels were prepared by the method of Latshaw and Reyerson (*J. Amer. Chem. Soc.*, 1925, **47**, 610) and copperized gel by saturating silica gel with N/5 copper nitrate solution, drying in hydrogen and completing the reduction in hydrogen above 250° C. The mixture of ethylene and hydrogen was passed over the catalyst maintained at the desired temperature and the extent of hydrogenation was determined by analyses of the product for ethylene. The effect of temperature and of the rate of flow and the composition of the gas mixture upon hydrogenation was determined for the three catalysts.

For a standard rate of flow of mixtures with 25 per cent. ethylene, over the range 0 to 240° C. the palladized and platinized gels reached their maximum efficiency at 60° C. (99·7 per cent. and 98·8 per cent. respectively), while the copperized gel, over the range —20 to 360° C., was most efficient at 240° C. (59·9 per cent.). The temperature-efficiency curve is normal for the first two metals, but irregular for copper, there being a minimum

at 30° C. This is attributed to the formation of an inactive copper hydride, most stable at room temperature.

A fall of efficiency was observed with increased gas velocity for all three catalysts, the effect being most marked with the copperized gel. It is suggested that this is due to the comparative scarcity of active areas in the copper catalyst in which the metal atoms are not in the crystal lattice of the metal (compare Reyerson, Harder and Swearingen, *J. Phys. Chem.*, 1926, **30**, 1623).

Experiments with gaseous mixtures of various compositions were carried out at 27 and 170° C., and indicated that the efficiency of all three catalysts was inversely proportional to the partial pressure of the ethylene. The palladium and platinum catalysts actually showed zero efficiency for a gas mixture with an ethylene content of 73 per cent. This is attributed to surface adsorption of the ethylene. R. P. L.

501. The Corrosive Influence of Sulphur and Sulphur Compounds in Naphtha Solutions. H. Schmidt. *Petroleum*, 1927, **23**, 646–648.

A petroleum fraction of sp. gr. 0·769 at 20° C., flash point 41° C. and initial b.p. 151° C., free from acid or sulphur, was employed as a solvent, and solutions of *iso*-amylmercaptan, hydrogen sulphide, dimethyl sulphate, *p*-toluene sulphonic acid, naphthionic acid, carbon disulphide, *n*-butyl sulphide, *n*-propyl disulphide, thiophene, diphenyl sulphoxide and *n*-sulphobutyl were prepared containing from 0·010 per cent. to 0·360 per cent. of sulphur. Tests of 3 hours duration were made in which polished strips of aluminium, zinc, steel, copper, brass and silver were immersed to 100 mm. depth in the solutions in a closed test tube and kept at a temperature of 50° C. Five-day tests were also made with the same procedure; the same tests with the addition of 2 c.c. of water, three-hour and five-day tests as in the first example, but at a temperature of 100° C.; tests in copper dish heated over water bath, and thirty-day tests at room temperature with the addition of water, in which the action on iron, galvanised iron, magnesium, chromium, cobalt, nickel, tinned iron, solder and mercury was observed. In the trials at 50° C. without water, iron, and aluminium were not attacked, zinc was feebly attacked by alkyl sulphate, brass was slightly corroded after five days, copper and silver were little affected by mercaptans, more by hydrogen sulphide, and energetically by free sulphur. In the tests with water, aluminium showed corrosion in many cases. The copper dish tests gave a deposit of copper sulphide with free sulphur, carbon disulphide and mercaptan. In the tests at 100° C. polymerisation was noted, but the cracking had no direct influence on corrosion. In the thirty-day tests chromium and zinc were most resistant; most metals were attacked, especially manganese. Mercaptans had the greatest corrosive influence. The corrosive action of the sulphur compounds corresponded to their capacity for ionisation. Heat promoted corrosion. H. M.

502. Equilibrium Conditions in the Formation of Hydrocarbons and Alcohols from Water Gas. D. F. Smith. *Ind. Eng. Chem.*, 1927, **19**, 801.

Theoretical. The free energy of formation of methane, ethane, propane and benzene, and of methyl, ethyl and *n*-propyl alcohols, are calculated. From these and from the free energy of CO and CO_2 the increases in energy brought about in the formation of these hydrocarbons and alcohols from CO and hydrogen are obtained. From these equations the free energy increase, ΔF, accompanying the formation of these compounds from water gas at any temperature, T is given by the usual equation $\Delta F = -RT\log_e K$.

The values of K at 25°, 300° and 400° C. for the seven compounds mentioned have been calculated along these lines. The values for K at all temperatures increase as the homologous series is ascended.

It is deduced that given suitable catalysts it should be possible to produce any of the paraffin hydrocarbons from water gas at atmospheric pressure and 300° C. From the thermodynamic standpoint the ease of formation depends directly on the pressure and inversely on the temperature. From the values of K obtained the maximum possible yields of any product under a definite set of conditions can be calculated. R. P. L.

503. Low Temperature Oxidation of Hydrocarbons. J. S. Lewis. *J. Chem. Soc.*, July, 1927, 1555–1572.

Using a Victor Meyer's apparatus, the author determined the molecular weight of hexane, heptane and octane at temperatures between 180° and 278° C., a regular diminution in all cases of apparent mol. wt. with rise of temperature indicated that oxidation was occurring. Further investigation of this oxidation comprised heating the paraffin and air in a closed bulb, the volume of gas being kept constant by continuous adjustment of pressure. It was found that at a certain temperature (the "critical inflexion temperature") a sudden rise of pressure was required to maintain the volume constant. This sudden rise must be due to an increase in the number of molecules. The C.I.T. is somewhat influenced by the rate of heating; octane, hexane and pentane show C.I.T.'s at 200°, 232° and 253° C. respectively. The ratio of paraffin to air in the bulb has only a slight effect on the C.I.T. The use of oyxgen instead of air lead to a sharper rise in pressure. After this sudden inflexion in the pressure rise, no further inflexion is necessary below 450°. An atmosphere of nitrogen instead of air gave no inflexion, showing that the reaction is an oxidation with an increase in the final number of molecules. *n*-Pentane and *iso*-pentane had C.I.T.'s of 253° and 260° respectively. Platinum in a suitable form started the oxidation at much lower temperatures than when absent, 130°–140°; at 275° a violent reaction took place, leaving carbon, carbon monoxide and carbon dioxide in the bulb. The presence of 1 per cent. lead tetraethyl completely eliminated the inflexions observed above; smaller quantities greatly reduced the size of the inflexion.

Spindle oil heated to 250° with lead tetraethyl undergoes no darkening, whereas in its absence it darkens rapidly; when exposed to sunlight, spindle oil with lead tetraethyl shows no darkening after some weeks. Bubbling air through spindle oil at 200° and 180° produced rapid darkening in the absence of lead tetraethyl, in its presence darkening only started after 3 hours; the darkening is accompanied by the formation of CO_2 and water. Thoroughly dry hexane and oxygen showed only a very small inflexion on heating. In the constant volume bulbs used for heating paraffins and air, after the reaction were found water, aldehydes, acids, oxides of carbon and a little gum, but no peroxides: the gum is thought to be formed on cooling as the result of condensation of the aldehydes. Using amylene and air in the bulb a downward inflexion in the pressure-temperature curve was observed between 232° and 254°, and no water was formed.

As the result of the above experiments the author discards the older hydroxyl theory of Bone and the peroxide theory of Callendar and postulates primary dehydrogenation at the C.I.T. with the formation of water; the fewer the carbon atoms in the main paraffin chain the less easily are the two hydrogen atoms split off. The elimination of two hydrogen atoms from heptane is accompanied by the evolution of heat; it is shown by

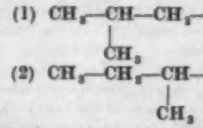
calculation that for a 10 per cent. heptane-air mixture, compression at a 3:1 ratio raises the temperature to 370°; dehydrogenation raises the temperature further to 770°, thus leading to detonation. The presence of unsaturateds in a motor fuel would depress the tendency of the paraffins to undergo primary dehydrogenation. Anti-knocks, such as the aromatic amines, may act by splitting into $C_6H_5+NH_2$ and combining endothermically with the hydrogen; further hydrogen iodide is formed endothermically, while hydrogen chloride and bromide are formed exothermically, iodine acts as an anti-knock, chlorine and bromine as slight pro-knocks. W. N. H.

504. Preparation of Tetraphenyl Lead. Gilman and Robinson. *J. Amer. Chem. Soc.*, 1927, **49**, 2315.

A modification of the method of Pfeiffer and Truskier (*Ber.*, 1904, **37**, 1125), giving a yield of 50 per cent. of nearly pure tetraphenyl lead, has been developed as the result of a study of the effect of conditions upon the reaction between lead chloride and phenyl magnesium bromide. New points arising from this work are as follows: (1) A very slight excess of the Grignard reagent is used, increase in the amount having no effect on the yield; (2) the diluent is a mixture of 1 part of ether to 2 parts of benzene; (3) a reaction period of 8 hours yields the best results; (4) lead chloride cannot be effectively replaced by the bromide, iodide or dioxide.
R. P. L.

505. The Spontaneous Oxidation of a Saturated Cyclic Hydrocarbon. G. Chavonne. *Bull. Soc. Chim. Belg.*, 36, 206. Feb., 1927.

The author has now proved that 1·3 dimethyl cyclopentane is oxidised at room temperature in diffused daylight, and has isolated the oxidation product. In this paper a quantity of the dimethyl cyclopentane was left in an atmosphere of oxygen in diffused daylight for 150 days till no more oxygen was observed to be absorbed. The initial compound was then distilled off showing the product of the reaction to be a peroxide, which was stable at ordinary temperatures and which in presence of potassium iodide, carbon dioxide and other substances gives a mixture of aliphatic ketones (1) methylisoamyl ketone and (2) methyl 2·4 hexanone



which must have been formed from the primary reaction product by rupture of the nucleus. Formation of acids by oxidation of the side chains was also observed. The investigation will be continued in an attempt to prepare dimethylcyclohexane from dimethylcyclopentane. A. R. S.

506. Velocity of Combustion and Gas Equilibria. *Allmer. Zeit. Ver. deut. Ing.*, 1927, **71**, 411. *Fuel*, July, 1927, 333.

Researches on gas equilibria and reaction velocity in flames of solid, liquid and gaseous bodies are reviewed. Even at high combustion temperatures the reaction time has a finite value and cannot be disregarded. The time and the retarding or accelerating effects of the combustion space determine how far reactions at high temperatures approach equilibrium and how far such equilibrium is displaced on reduction in temperature. G. S.

507. Improvements in the Manufacture and Production of Solid Sodium Hypochlorite Preparations. M. P. Appleboy and C. Carter. E.P. 274,197. July 18, 1927.

At the present time sodium hypochlorite is only marketed in the form of solutions, and the latter suffer from the disability that the concentration of the active ingredient, namely chlorine, is limited in general commercial practice to 15 per cent. According to this invention, preparations of stable sodium hypochlorite are obtained in solid and dry form by admixture of a strong solution of the hypochlorite with partially or wholly dehydrated salts of sufficiently alkaline character. These salts should be capable of forming stable hydrates or of forming sodium salts by reaction of the hypochlorite, with the stable hydrate. Again, they must be capable after admixture with the hypochlorite of bringing about a certain withdrawal of water from the latter, either by (*a*) direct combination with such water or (*b*) by interaction with the hypochlorite to produce some salt other than the original, which will pick up water. Sodium metaborate is a salt which will fulfil the above conditions.

Note.—A method for the manufacture of solid sodium hypochlorite is described in E.P. 25,925, 1898. W. H. T.

508. Improvements in the Manufacture and Production of Solid Sodium Hypochlorite Preparations. M. P. Appleboy and C. Carter. E.P. 274,198, 1926.

Solid, dry and stable preparations of sodium hypochlorite are produced by the admixture of sodium hypochlorite with wholly or partially dehydrated tri-sodium phosphate or other wholly or partially dehydrated salts which will form tri-sodium phosphate; *e.g.*, di-sodium hydrogen phosphate and caustic soda. The sodium hypochlorite may be used in solution or in the molten form, or in crystal form. Thus, to a solution containing 100 parts of sodium hypochlorite of 30 per cent. available chlorine, 56 parts of dehydrated tri-sodium phosphate are added, working at a temperature of 35° C. In a second example, 35 parts of tri-sodium phosphate are mixed with 100 parts of sodium hypochlorite crystals melted in their water of crystallisation, the working temperature being in the region of 30° C. H. G. S.

509. Process for the Preparation of Mixtures of Carbon Monoxide and Hydrogen from Hydrocarbons. L. Casale. E.P. 274,610. July 28, 1927.

The process depends upon the reaction between hydrocarbons and water at high temperature. In such decompositions methane is the last intermediate to disappear and special precautions must be taken for its elimination. This is achieved in the present invention by passing mixtures of gaseous hydrocarbons and steam either alone or mixed with air or with air enriched by oxygen into a reaction vessel maintained at a temperature above 1000° C. The necessary heat is supplied by the reaction itself and can be regulated by the amount of oxygen admitted. The working pressure is slightly below atmospheric and is maintained by a blower. If hydrogen alone is required the gaseous products are cooled to about 500° C. by the introduction of steam, the carbon monoxide is converted into the dioxide catalytically and the latter is removed. R. P. L.

510. Improved Process for Producing Mixed Phenols and Related Compounds. R. Cross. E.P. 275,313. Aug. 3, 1927.

Coal tar or its heavier distillates are subjected to cracking conditions of temperature and pressure, ($t = 700$—$1000°$ F. and $p > 350$ lbs./sq. in.)

The evolved vapours are collected, the phenols dissolved from the resulting distillate by caustic soda solution and recovered by acidification. With some grades of tar it is advantageous to add alcohols, glycols or other hydroxyl-containing substances. The temperature and pressure are so regulated as to prevent material vaporisation during cracking and then releasing the pressure and using the contained heat of the oil to effect distillation. In a typical experiment a heavy distillate from German coal tar gave some 30 per cent. of substances soluble in caustic soda and 30 per cent. of aromatic hydrocarbons. A diagram of the apparatus is given.

R. P. L.

511. Improvements in the Purification of Hydrocarbons. I.-G. Farbenindustrie Aktiengesellschaft. E.P. 255,905. July 14, 1927.

The invention relates to the purification of hydrocarbon mixtures composed of constituents of high boiling point with a view to removing compounds such as resinous bodies, asphalts and the like. The process consists in treating the hydrocarbon mixture with a mixture of methanol and cyclic hydrocarbons of low boiling point such as benzene, toluene, xylene and cyclohexane. It is preferable to use the methanol in a predominant amount, as for example, 4 parts of methanol and 1 part of benzene by volume. The impurities contained in crude hydrocarbon mixtures are readily soluble in this mixture while the constituents of mineral oil character of higher boiling point belonging to the paraffin and naphthene series are insoluble therein. The washing operation is preferably carried out in a counter-current. For example, a high tower or column filled with Raschig rings or the like may be employed and the crude hydrocarbon mixture introduced near the top and the methanol mixture near the bottom. Then the refined oil may be withdrawn from the bottom of the column and the methanol mixture, containing all the tarry impurities may be withdrawn from the top. It is claimed that a residue resulting from the distillation of destructively hydrogenated brown coal producer tar refined by this method gives a nearly colourless oil of good value. It is further claimed that the process is of particular advantage for the purification and separation of lubricating oils. S. W. C.

512. Manufacture of Cyclic Hydrocarbons and Derivatives thereof. I.-G. Farbenindustrie Aktiengesellschaft. E.P. 253,911. Aug. 18, 1927. (Compare E.P. 251,270 and Elbs, *J. für Prak. Chem.*, **35**, 471).

An extension of an earlier process whereby cyclic hydrocarbons are produced by passing the vapour of certain aromatic or mixed aliphatic-aromatic ketones over a heated porous material.

Secondary aromatic or aliphatic-aromatic alcohols with a methyl or methylene group *ortho* to the carbinol are subjected to ring closure by passing the vapour over a highly porous body. The alcohol may be free or in the form of an ether or ester. Secondary reactions due to the reducing action of the hydrogen produced are avoided by mixing the alcohol vapour with oxygen itself or a substance capable of yielding it. A similar reaction is effected using diaryl methanes with a methyl group *ortho* to the methane carbon. Typical catalysts are active charcoal alone or charged with cobalt, copper or manganese oxides.

In this way m-xylyl phenyl carbinol at 360—380° C. gave 35 per cent. of β-methyl anthracene; di-p-xylyl carbinol at 400° gave 50 per cent. of 1:4:6 trimethyl anthracene; m-xylyl phenyl carbinol acetate at 400° gave 30 per cent. of β-methyl anthracene; and m-xylyl phenyl methane at 400° gave 40 per cent. β-methyl anthracene. R. P. L.

513. Process for the Production of Resinous Condensation Products from Amines of the Aromatic Series. I.-G. Farbenindustrie Aktiengesellschaft. E.P. 274,155. July 15, 1927.

The invention provides for a process for the production of resinous condensation products by the action of formaldehyde upon amines of the aromatic series in the presence of an amine salt which consists in carrying out the condensation in aqueous solutions of alcohols in which the amino bases are soluble, in the presence of an amount of dissolved amino salt not substantially exceeding 10 per cent. of the amount of amine employed and in regulating the softening point and other physical properties of the resulting resinous condensation product by adjusting the amount of the amino salt present during condensation. The softening point of the resin can, in many cases, be further increased with the same salt content by increasing the amount of aldehyde above the molecular ratio. Further, if the reaction be carried out at or above the boiling point of the aqueous-alcoholic phase an equal yield of a product of equal softening point may be obtained by keeping the salt content or the addition of acid slightly lower than that when working at temperatures below boiling temperature. The isolated oily or solid resinous products are freed from volatilisable admixture by heating *in vacuo*. It is claimed that the products are particularly useful as resists in the dyeing industry. S. W. C.

514. Light Hydrocarbons from Hydroxylated, Carboxylated and like Oxygenated Organic Compounds by Heat. Hydrogen under Pressure and a Dehydrating Catalyst. J. M. Florentin, A. J. Kling and C. Matignon. E.P. 263,082. Aug. 26, 1927.

The process consists in treating the oxygenated organic compound in the continuous liquid phase at a temperature of 350—480° C. with hydrogen at a pressure of at least 45 kg. per sq. cm. in the presence of thoria as catalyst. The raw material used may be an animal or vegetable oil or a mixture of oxygenated oil with hydrocarbons as in the case of Autun shale oil. Saturated hydrocarbons are formed, a typical experiment on shale oil yielding a product of which 48 per cent. distilled below 205° C. R. P. L.

515. Method for Synthesizing and Separating Higher Alcohols. G. Patart. E.P. 250,563. Aug. 29, 1927.

Higher alcohols are produced from the reaction of hydrogen and carbon monoxide in gas mixtures at high temperatures and pressures in the presence of catalysts. Special catalysts are required to prevent the formation of hydrocarbons and to diminish that of methyl alcohol while maintaining a high throughput. These are composed of alkali or alkaline earth salts of acidic metal oxides such as those of manganese and vanadium or of the chromium-tungsten group, together with a methanol-forming oxide such as zinc oxide or pyrolusite. Thus, a typical catalyst consists of pyrolusite, and barium tungstate mixed with a binding material, and dried and broken to a granular form.

The gas mixture, such as industrial water gas, is circulated over the catalyst and is subsequently cooled without releasing the pressure to condense the alcohols and water formed. The condensate so formed is separated into two layers, further quantities of alcohols being salted out from the lower (aqueous) layer. The mixed alcohols are fractionated, about three-fifths consisting of propyl, butyl and amyl alcohols.

The uncondensed gas mixture is freed from carbon dioxide by further cooling while still under a pressure of 500—800 atmospheres. The resulting

gases containing 2—3 per cent. of carbon dioxide are recirculated. An apparatus for carrying out the process on the industrial scale and the system of heat interchange between the various stages of the reaction are described. R. P. L.

516. Process of Regeneration of Contact Masses for the Catalytic Hydrogenation of Carbon Oxides. G. Patart. E.P. 252,361. Aug. 12, 1927.

If the reacting gases used in the preparation of methyl alcohol, etc., by hydrogenation of carbon oxides are not freed from sulphur, catalysts of the basic zinc chromate, tungstate, vanadate, manganate type become poisoned after a period of activity of some 200 hours. These catalysts, in the form of grains, can then be regenerated by calcination of the spent mass either in an open crucible or by slow circulation through an oxidising flame. The sulphur compounds are expelled by sublimation and oxidation and the lower oxides of chromium, tungsten, etc., are raised to the higher state and reform the active compounds with the zinc oxide. R. P. L.

See also Abstracts Nos. 543, 546, 559, 563, 621 and 629.

Crude Oil.

517. Preliminary Purification of Crude Oil. *Petr. Times*, 1927, xviii. (448), 324.

Remedies for the corrosion problems met with in the refining of crude oil are usually suggested in connection with the materials used for the plant. Corrosion may also be reduced by preliminary treatment of the crude, and P. Runge (*Nat. Petr. News*, June 8, 1927) deals with the treatment of crude oil to remove corrosive and other troublesome substances.

Waters associated with crude petroleum usually contain sodium chloride and magnesium chloride. The former is the least harmful, but the latter decomposes at about 223° F. into magnesium oxychloride and free hydrochloric acid. Under severe conditions the acid will destroy steel pipe in five to seven days, particularly if the weld is exposed. Cast iron pipe will withstand corrosion for a considerable period, but eventually becomes reduced to the consistency of putty.

Where sulphur is not present and salt and salt water have been previously removed, brass pipes are satisfactory, and the initial high cost may prove economical.

Two methods are used for the elimination of corrosion and salt deposition. The first, the removal of salt and salt water before distillation, is usually the best. The second method is to neutralise the acid formed during distillation.

Of the preliminary treatments, washing the crude with hot water is one of the best, and the oil may be completely freed from soluble salts. Time and expense are involved, but are probably justified by the results obtained.

The use of anhydrous, or partly anhydrous, calcium chloride has been proposed, and it is probable that a simple filtration method to retain water and salts in the filtering medium could be evolved. G. S.

518. Properties of Some Typical Crudes in Venezuela—Some Comparisons. Kraemer. *Oil & Gas. J.* Aug. 4, 1927.

Tables are given of the constants of various samples of crude from Venezuela, together with the percentage of gasoline obtained and the carbon residue of the residuum.

A further table gives specific gravity figures for the fraction distilling at atmospheric pressure between 250–275° C., and pour points of those distilling under 40 mms. pressure between 275–300° C. together with an indication of the base of the crude. A. R. S.

519. Process for Dehydrating Oils. S. Born, H. E. Bonnette and J. C. Walker. Assrs. to Empire Gasoline Co., Delaware. U.S.P. 1,639,325. Aug. 16, 1927. Appl., April 20, 1920.

A process for the separation of emulsions of oil and water such as are obtained from oil wells; a means whereby bottom settlings and semi-solid emulsions are avoided; and a method by which an emulsion may be completely removed from an oil by the addition of a minimum quantity of a reagent for precipitating and breaking it up.

All the water which will separate from the oil is first allowed to settle out. Sodium hydroxide is then mixed with the separated water to the extent of 0·2 to 0·4 per cent., the hardness of the water being inappreciably effected thereby. This alkaline solution is then mixed with the emulsion from which no more water will separate, and the whole heated to approximately 150 to 160° F. Upon standing, the saline solution separates from the main body of the oil as a comparatively clear liquid. Any emulsion remaining is decomposed by a further treatment with an additional quantity of alkali, and heating to a higher temperature, approximately 180° F.

A flow sheet is given showing how the oil may be progressively treated, heated and cooled by steam coils and heat interchangers, and the alkaline solution re-used until the absorbed sulphur or sulphur compounds and other impurities from the oil render it unfit for further use when it is discarded. H. S. G.

520. Contacting Means. H. E. Boner. U.S.P. 1,637,468. August 2, 1927.

The invention provides apparatus for effecting intimate contact of a liquid with a gas or vapour. Heated crude oil is introduced into an absorption tower at a suitable point, its temperature depending upon what fraction it is desired to take off. From the receiver the oil passes through a stripper section where the desired fraction is taken off, and with it perhaps heavier fractions. This stripper section is constructed of a plurality of screens of a typical form and are substantially the same wherever screens are used within the tower. They are constructed in such a way that the oil current moving across an upper screen moves in a reverse direction from that crossing the next lower screen. From the receiver the oil passes through a down pipe on to the uppermost screen, whose middle portion constitutes a perforate area, on the side of which, remote from the point of admission of the oil, the screen has an imperforate area and the space above this imperforate area is intended to act as a coalescing zone for the froth which passes off the perforate area. In order that the oil shall flow in a current along the upper face of the plate an oil trough is provided which extends transversely of the screen and toward one side. At one side this trough is provided with an outlet formed by cutting a long notch in the upper edge of the trough on this side. Where the oil treated is light, as in a fractionating tower, a baffle plate is provided between this outlet and the perforate area, which prevents the overflow of oil from splashing on to the froth. The lower edge of this baffle is elevated so as to form a passageway through which the oil is guided in a current flowing across the plate. Above the perforate area is placed a spatter plate, which prevents any possibility of oil from a lower screen being entrained or carried up through the froth on to the screen above it. Below the screens of the stripper section

is provided the inlet for the heated gas or vapour, such as steam. The vapours accumulating below the receiver are carried directly through the body of oil within the receiver. For this purpose a plurality of bubbling nipples, fitted with inverted cup-shaped caps, is provided. The vapours pass upwardly from the lower edges of the caps and bubble up through the body of the oil, passing through the upper wall of the receiver through similar nipples and caps. From this point the vapours pass on up through a number of screens constituting the washing section. Above this is provided a re-boiler, which is located below the fractionating section of the tower and collects oil accumulating in the fractionating section. This re-boiler is constructed of a plurality of vertical tubes open at both ends, and the upper ends of which extend above the level of oil in the re-boiler. The re-boiler has a delivery outlet, provided with a trap, from which the oil may be passed off and cooled for storage if desired. Below the level of this outlet is another, which communicates by a pipe connection and valve with a spout which delivers distillate oil into the oil trough of the uppermost screen of the washing section. This serves to condense the heavier vapours which have come up from the stripper section. The lighter vapours pass on up through the tubes of the re-boiler and into the fractionating section. This section is constructed of screens similar to the washing and stripper sections. The lowermost screen is provided with a down-pipe, which delivers oil coming from the fractionating section into the re-boiler through an oil-seal. As the lighter vapours pass on up through the fractionating section they are brought into contact with the condensate of substantially the desired fraction. For this purpose a reflux inlet brings back some of this condensate from a condenser. This inlet has a down-pipe, which delivers the oil into a trough from which the oil passes in succession down and across the different screens which compose the fractionating section. The upper head or dome of the fractionating section is provided with an outlet from which the desired fraction is led to a cooler and storage.

It is claimed that by this method there is no carrying of liquid from one plate to another, either by splashing or mechanical entrainment. Further, that there is movement of liquid over the entire surface of the plate so that the desired action may take place at every point on the plate. Again, that the froth formed in the apparatus breaks down quickly so that there is no fear of the down-pipe being choked with froth thus causing a flooding of the tower. S. W. C.

521. Process for Breaking Petroleum Emulsions. M. de Groote and W. C. Adams. U.S.P. 1,641,804.

This patent describes the use of any condensation product of a sulphonated polycyclic aromatic with two saponifiable radicles as emulsions breakers.

The usual method of preparing these substances is to heat a sulphonated polycyclic aromatic, which has already been combined with one saponifiable substance, with a second saponifiable substance.

The treatment of the oil with the emulsion breaker may be carried out in any of the accepted ways. K. B. R.

522. Improvements Relating to the Distillation of Crude Oils. F. Tinker. E.P. 274,959. July 28. 1927.

The patent refers to conservation of heat by the method of exchangers. It provides for the use of a common mixing chamber, into which hot liquid or vapour or mixtures of liquid and vapour derived from different parts of the system, can be delivered. Thus the heat given up in the cooling of distillates and residues is able to be utilised economically to reduce initial

cost and upkeep charges in the fire-heated part of the system, and generally effect important economies in the operation of distillation plants.

Two streams of the crude oil enter the mixing chamber. The first is preheated by the residuum from the vapour separator and then passed through a pipe still where it is raised to the desired temperature. The second is preheated by the condensed reflux and then passed through a coil in the vapour space of the reflux condenser or fractionating column. In the mixing chamber the two streams are thoroughly mixed and then passed on to a vapour separator. From here the residuum goes to preheat one stream of crude oil, whilst the vapours pass on through a reflux condenser where they heat the other stream of crude oil. S. W. C.

523. Purification of Oils. F. W. Weber. U.S.P. 1,636,946. July 26, 1927.

The invention relates to the purification of crude oils and their distillation products, including those obtained by cracking. The oil is first filtered to separate any foreign matter, and then water is added, the whole being agitated vigorously until an emulsion is formed. A hypo-halite, such as calcium hypochlorite, is then added in the form of a fine powder. It is found that the effect of the hypochlorous acid is greater when the water and oil are in an emulsion. This operation is carried out at atmospheric temperature, though slight heat may be applied to accelerate oxidation of certain substances. after agitating for 15 minutes the sludge is allowed to settle, and drawn off. More water is then added to the oil, agitation continued for 30 minutes to dissolve out any reaction products, the water allowed to settle and drawn off. This washing may be repeated if necessary. Next is introduced into the oil a solution of an agent soluble in water and capable of generating active oxygen, such as hydrogen peroxide, sodium perborate, etc. This is performed at elevated temperature for the purpose of oxydising any organic compound formed during the treatment of the oil with the hypo-halite and of bringing such compounds into water soluble form. The reaction mixture is again allowed to settle and the aqueous layer drawn off. The oil is then treated with sulphuric acid, such as 66° Bé., care being taken that the oil is vigorously agitated during the introduction, the temperature being kept at atmospheric or only slightly elevated. The action of the sulphuric acid is complete in half an hour, and thereupon the mixture is allowed to stand overnight, a heavy sludge accumulating at the bottom, which is drawn off in the usual manner. A certain amount of sulphuric acid remains in the oil. A practically saturated solution of a salt formed by a water soluble base, with a metal oxide of acid character, such as sodium silicate, etc., is then added to the oil. These salts undergo decomposition in contact with acid forming the corresponding salt of that acid with the base of the applied metal hydroxide which precipitates in a voluminous flocculent form. The oil is vigorously agitated during the addition of the salt solution, the amount of which must be in considerable excess of that required for the neutralisation of the acid remaining in the oil. By this means the fine heavy drops of the surplus solution engage the fine light floccules of the metal hydroxide and pull them down immediately the agitation is stopped. This yields in the course of a few minutes a clear, neutral and odourless oil which is drawn off, the sediment which is accumulated at the bottom of the vessel containing besides the metal hydroxide all the colouring matter previously dissolved in the oil.

With oils of a very refractory character the generation of the metal hydroxide is brought about in a different manner. First, a certain quantity of a colloidal ferric chloride liquor is added to the oil. This liquor is made by dissolving 1 lb. of crystalline ferric chloride in 1 lb. of water and diluting this

solution to 1 litre; to 200 c.c. of this solution is added 25 grammes of a mixture of the carbonates of all the rare earth metals found in Monazite sand, and with a copious discharge of gases a dark-red transparent solution is obtained. This solution yields a voluminous precipitate in contact with sulphuric acid which displays a great power of absorption, which exerts itself favourably in the desulphurisation of the oil. This solution is added to the oil in the proportion of 15 c.c. per litre, and the precipitate of ferric hydroxide is formed immediately. This liberates a certain amount of acid and the sodium silicate is then added, neutralising the acid and causing a heavy precipitate of silicon hydroxide. Simultaneously the rare earth metals are precipitated in the form of their hydroxides, and these, with the silicon and ferric hydroxides, exert an excellent effect in the purification of the oil on account of their enormous capability of occluding all discolouring and odourous matters. After the oil has been separated from the precipitate of hydroxides it can be distilled in the presence of sodium carbonate either by direct heat or by steam.

It is claimed that this process, easily and quickly operated, requires only low-priced chemicals and can be operated with apparatus already in general use. It is further claimed that the product is free of any colouring matter and has a pleasant smell which does not change even on exposure to sunlight for a great length of time, and is free of chlorine and sulphur, or contains such small amounts of the latter as to comply with the highest requirements of the market.

S. W. C.

Natural Gas.

524. Close Temperature Control in Natural Gasoline Plant Eliminates Re-runs, Uses Less Steam. R. P. Van Vliet. *Oil Age*, Aug., 1927.

After a fire which destroyed the previous control devices, the Phillips Petroleum Company, of Stroud, Oklahoma, installed the Taylor Instrument Co.'s Tycos Type P temperature regulators. These were installed on a fire-still type natural gasoline plant circulating 68,784 gallons of oil daily, absorbing about 4,000 gallons of gasoline from 1,000,000 c. ft. of gas. The controls were set for 450° F. on stills, 192° F. on knockout, and 90° F. on steam tank, and it was found that the temperatures could be readily maintained within 1° F. of the desired values. This eliminated entirely all re-runs and all loss in steaming. The former regulators gave an impact effect, causing temperatures to swing above or below the critical point and necessitating re-runs on 10 per cent. of the output. Natural gas is used as an actuating medium for the controls, and except for the necessity of spending two hours a week in blowing deposits out of the control lines there would be no maintenance cost whatever on any of the control equipment. It is estimated that the net annual savings effected by the installation of this equipment amount to $3,924·26, which repays the cost of new equipment eleven times annually.

S. W. C.

525. Computing Gas Volume by Slide Scale. E. J. Jones. *Oil & Gas. J.*, 1927, **26** (14), 166.

The slide-rule used is built more or less to order, based on varying barometric pressure bases. It is similar in construction to the ordinary slide-rule, being 45 ins. long and 6½ ins. wide. Two hairline indicators are provided and a magnifier may be used.

The lower scale on the rule shows the coefficient, the corresponding scale on the slide being the static scale. The upper scale on the slide shows the differential, and from the top scale of the rule the volume is read.

As an example, assuming the co-efficient to be 2,954·183, the differential 10 ins., and the static pressure 20 lb., the extension from the pressure extension book is 18·547, and the calculating machine shows the volume to be 54,791·232101 c. ft. By the slide-rule the volume is read as 54,800 c. ft.

For comparison purposes a series of tests using 62 orifice meter charts were made. An experienced operator, using a calculating machine, required 9½ hours to compute the volumes. By the use of the slide-rule only 4 hours were required, and the volumes by each method varied by less than 0·1 per cent.

G. S.

526. Extract Methane from Natural Gas. Greenwald. *Oil & Gas J.*, Aug. 4, 1927.

The natural gas passes through a meter and soda-lime box, and then is caused to flow into a bomb placed in an insulated container containing liquid air. The contraction of the gases in liquefaction caused the bomb to be under a slight vacuum, and gas is passed in until this vacuum ceases to be apparent. The permanent gases in the top of the bomb are then allowed to stream away, after which it is removed from the liquid air bath and gas cylinders filled with the liquefied methane.

Results obtained using this method :—

	Natural Gas %.	Methane %.
Methane	88·0 ..	99·1
Ethane	6·9 ..	0·7
Propane	2·6 ..	0·0
Butane	0·8 ..	0·0
Nitrogen	1·7 ..	0·2

A. R. S.

527. Industry's Technicians Responsible for Extraction Methods. G. S. Reid. *The Refiner*. Aug., 1927.

One of the most important tests prevailing with the laboratories of the modern progressive absorption gasoline plant operating companies is the frequent examination of the gas being processed and the inspection of the absorption oil for saturation. The saturation test of the lean oil after it leaves the still is indicative of the amount of gasoline being removed from the oil in the distillation process. The efficiency of the absorber tower is determined by frequent testing of the fat oil while en route from the absorber tower to the distillation unit, and thus the efficiency of the absorbent is also determined and checked. The difference between fat and lean oil saturation is an indicator of the plant production when computed on the basis of oil circulated to the towers. A second important test is the determination of the gasoline content of the natural gas being treated, and this is applied to both wet and dry gas. There are several methods of carrying this out. One is to have two drums filled with water, and then the small lines leading from the wet and dry gas mains are opened, which permits the wet gas to enter the small drum and the dry gas to enter the large drum. The valve on the water outlet line is opened just wide enough to permit just enough water to escape from the drums so that the gas displaces the water from each drum in 24 hours. At the end of the 24 hours the gas is measured from the drums through a meter and subjected to selective absorption by 250 c.c. of activated cocoanut charcoal; subsequently distilled in the presence of glycerine, and by this means the analysis of the two gas samples indicates the number of gallons of gasoline per thousand cubic feet of gas, while the dry gas analysis is indicative of the efficiency of the absorber towers.

For sampling the natural gas a Hutchinson orifice meter and gas absorber is extensively employed. In this device the gas is passed through the pressure regulator and then through a platinum orifice plate to the charcoal cylinder, which contains 250 c.c. of the activated charcoal. The usual temperature method is used in sampling the gas, observation being made up to and including the fourth temperature rise, at which point the tube of charcoal is considered saturated. The tube is then closed tightly and the distillation is carried out in a Braun type all-metal apparatus. The saturated charcoal is placed in a copper flask with 200 c.c. of glycerine. The usual 100 c.c. graduated cylinder is employed as receiver, but having no lip, and is enclosed in a wire jacket. The pressure is built up to about 30 lb. per square inch, and excess pressure released through a mercury sealed regulator. Distillation is carried on at this pressure till about 20 c.c. of glycerine has been distilled, the temperature reaching 550–600° F. The volume of condensate is read under pressure, the volume of glycerine being disregarded and the gasoline content is determined from that reading. Both charcoal and glycerine are recovered and used again, the former after re-activation. The charcoal is tested for activation before use by the carbon tetrachloride method. Compressed air, dried by passing it through 3 bottles of sulphuric acid, is then passed through 3 bottles of chemically pure carbon tetrachloride immersed in an ice bath at 32° F. The mixture of air and CCl_4 vapours is then passed through an accurately calibrated platinum orifice meter at the rate of exactly ·027 c. ft. per minute, passing downward through the sample of charcoal being tested. The outlet of the charcoal tube enters a mixing chamber through which is flowing ordinary plant dry gas, leading to a burner, in the flame of which is suspended a fine copper coil. When the charcoal becomes saturated with carbon tetrachloride vapours, the excess enters the gas burning at the jet and so up to the copper coil which is kept at a white heat and with which it combines, giving a green flame. Accurate determinations are made by observing the flame through a cobalt glass. The carbon tetrachloride time for good carbon is from 13 to 16 minutes.

For the computation of gas flow through the Hutchinson gas absorber it is necessary to know the specific gravity of the gas. This can be determined either by the Schilling bottle or the Edwards balance. In testing producing wells by the charcoal method a complete test car is maintained, equipped with a Vernon vacuum pump fastened to the engine frame and belt driven from the fan pulley. The vacuum pump overcomes approximately 10 inches of well vacuum and discharges the gas at pressures high enough to run the charcoal and specific gravity test.

On the big scale plant control of the volume of gas entering each absorber tower is secured by regulating with the block valves placed on the gas inlet lines, each of which is fitted with a manometer, the readings on which are recorded hourly. This insures that each absorber tower in the series treats a like volume of gas daily. Further, a separate block valve oil meter is fitted to each tower so that the volume of lean oil entering each tower is under control. These together assure that at no time will any one tower be overburdened with rich gas, or flooded with lean oil, or under-supplied with both. S. W. C.

528. Natural Gasoline as an Aviation Spirit. *Petr. Times.* Aug. 6, 1927.

Comparative tests were carried out on a Waco aeroplane fitted with a 90 h.p. OX5 Curtiss engine to determine the relative merits as a fuel of pure natural gasoline, s.g. ·686, and a 50/50 blend of natural gasoline and aviation spirit, s.g. ·703. With natural gasoline a 3 per cent. shortening in the take-off

run was noted and a 15 per cent. improvement in the one minute climb, compared with the performance of the blend. W. N. H.

529. Dissociation of Carbonaceous Gases or Vapours. Canada Carbide Co. E.P. 274,573. July 25, 1927.

Endothermic hydrocarbon gases are passed into a heated reaction chamber with the minimum amount of preheating to avoid polymerisation. The gas is then suddenly heated to the temperature required for dissociation. The heat liberated is conserved by the refractory walls of the chamber while the hydrogen and carbon black are allowed to pass without cooling from its base. The effluent hydrogen acts as a seal to prevent the entry of air.

Typical starting materials are acetylene or mixtures of acetylene and natural gas of high methane content. The preliminary cooling of the inlet pipe may be carried out by a stream of air or other gas. The reaction pressure used is slightly over atmospheric. The hydrogen is conveniently burnt at the base of the chamber in a stream of air admitted from a side conduit. Using a brick-lined retort the amorphous carbon formed falls from the retort through the flame, which serves to burn oily impurities. The carbon black is carried by draught from a stack through a chamber containing baffles, and is removed from the base of this by a screw conveyor. Drawings of the plant are given. R. P. L.

530. Improvements in and relating to the Manufacture of Active Carbon. *I. G. Farbenindustrie Aktiengesellschaft.* E.P. 251,636. July 28, 1927.

Carbonaceous material is treated with sulphuric acid with gentle heating to a red heat, and subsequently treated with open steam while maintaining the mass at glowing heat. A. R. S.

See also Abstracts Nos. 531 and 591.

Motor Spirit.

531. Blending of Distillates and Natural Gas Condensates. G. Reid. *Refiner*, July, 1927.

Small quantities of compression gasoline are blended with distillates in order to lower the initial boiling point and the gravity. When supplies of compression gasoline are large, a further object of the blender is to decrease the "wildness" of the compression gasoline so that it can be handled by the refiner without excessive losses. These results may be achieved by blending the cold liquids. The author describes a hot-blending system which it is claimed obtains good results with the use of less of the heavy distillate.

The process is as follows:—

The compression gasoline and distillate are both raised to about 330° F. in separate preheaters and are then introduced into the evaporator, the gasoline vapour passing into the bottom and the liquid distillate into the top section, from which it falls through the vapour in counter-current flow. The bottom of the evaporator is heated by steam under 120 lb. per sq. in. pressure, and a certain amount of steam at 15 lb. is also passed into the bottom section. The unused liquid from the bottom is drawn off and returned to the distillate preheater. The vapours from the evaporator are passed to a dephlegmator through a "knock-out" box. The reflux from the box is returned to the middle section of the evaporator. In the dephlegmator the vapours are cooled to 200° F. and the reflux is returned to the gasoline

preheater. The vapours are then cooled by a spray cooler, the water is separated off and the finished gasoline sent to storage. The uncondensed vapours are passed through a compressor, the recovered compression gasoline being returned to stock. No mention is made as to the extent of the recovery in the compressor.

As an example of the effect of blending on the evaporation losses of compression gasoline, and on the vapour pressure, the following cases are cited :—

	Compression Gasoline.	Distillate.	Blend.
I.B.A.	40° F.	170° F.	58° F.
F.B.P.	235° F.	482° F.	318° F.
Vapour pressure	26 lb./sq. in.		10 lb./sq. in.

Blend contains 4 per cent. distillate.

	Compression Gasoline.	Distillate.	Blend.
I.B.P.	63° F.	258° F.	70° F.
F.B.P.	360° F.	436° F.	398° F.
Per cent. recovery on distillation	64		88-90.

Blend contains 8 per cent. distillate. P. D.

532. Comparative Starting Abilities of Motor Fuels. D. C. Ritchie. *Oil and Gas J.* July 28, 1927.

Air, at known temperature, was passed downwards with petrol through a coil immersed in a thermostat ; the rate of flow of air and petrol was adjusted. The unevaporated portion of the petrol was collected, the mixture of air and petrol vapour passed through a circular glass bomb in which a spark gap was located centrally. The explosive limits of the mixture were thus determined. It was found that the lean limit for air-fuel mixtures lay between 24-9:1 and 26-1:1 and that no average difference could be observed between a cracked or a straight-run spirit. W. N. H.

533. Apparatus for Reclaiming Used Gasoline. W. C. Glover. U.S.P. 1,639,373. Aug. 16, 1927. Appl., Oct. 23, 1922.

An apparatus intended for clarifying and reclaiming gasoline used in closed cleaning systems wherein dirt and other foreign matter accumulates in the washer.

It consists of a tank, preferably cylindrical, and of suitable material supported on legs of angle iron, with an inverted cone-shaped bottom connected to an offtake pipe and valve. The top of the tank may be permanently closed.

Within the tank, immediately above the base of the bottom, is a conical baffle with its apex to one side of the centre. Communication between upper and lower chambers is by a small annular opening round the edge of the baffle. The baffle is suspended from a vent pipe extending through the top of the tank and through the upper chamber, connected at the apex of the cone so as to remove entrapped air from the lower chamber. Means are provided for returning any vapours condensed in the vent pipe to the upper chamber at a depth sufficient to avoid agitation.

The dirty gasoline supply-pipe extends through the tank and baffle to near the bottom of the lower chamber and is there provided with curved nozzles to discharge the liquid with a swirling motion to facilitate its distribution through a chemical bath.

Caustic soda or other chemical solution is supplied through an inlet-pipe just above the baffle in quantity sufficient to fill the lower chamber to a level just above the top of the conical bottom.

Outlets, each provided with a valve, in the upper tank at different levels connect to a pipe so that the purified gasoline may be drawn off from the highest level. A gauge is provided on the tank. Impurities are withdrawn from the bottom from time to time. H. S. G.

534. Refining Hydrocarbon Oils. P. McMichael. U.S.P. 1,641,546. Sept., 1927. Appl., May 25, 1925.

The process is particularly applicable to the refining of cracked oils. The cracked distillate is vigorously agitated with sulphur dioxide gas, then filtered through a bed of absorbent material such as fuller's earth, infusorial earth or silica gel. After treatment with the absorbent material the oil is washed with water or a mild alkaline solution. If the spirit remains positive to the "doctor test" it may be further treated with hypochlorite or a solution of sodium plumbite. If a more refined product is desired the oil may be redistilled with steam. R. P.

535. Fuel for Internal Combustion Engines. H. F. Parker. E.P. 275,334. Aug. 5, 1927.

Aromatic extract by the solvent action of liquid SO_2 on kerosine is added to other kerosine, the mixture is thus capable of running in high-compression engines without detonation. In airships this fuel may be used, mixed with hydrogen, whereby a high water recovery is obtained. W. N. H.

See also Abstracts Nos. 503, 523, 524, 527, 528, 554, 593, 594, 598, 599, 600, 602 and 637.

Kerosine.

536. Process of Purifying Petroleum Products. Samuel J. Dickey and Raymond C. Wheeler. U.S.P. 1,639,988. Aug. 23, 1927.

A neutral petroleum distillate is produced from an acid treated distillate by settling and removing the coarse sludge, passing the acid distillate through a pack of dried sand, in a partially closed vessel, for the removal of fine sludge. Filtration is continued until the sand becomes clogged and ceases to function. Filtration is then stopped, the free oil drained from the vessel, the sludge washed out with steam and the sand dried by a current of air. The sand is thus reconditioned without removal from its container. G. S.

537. Treatment of Hydrocarbons. O. J. Imray and Ollgemeine Gesellschaft für Chemische Industrie, Berlin. E.P. 275,884. March 2, 1927.

Improvements and further developments of process and apparatus described in E.P. 114,845 for continuously refining hydrocarbons by treatment with liquid sulphur dioxide in which the two fractions of the hydrocarbons are led to evaporators where the sulphur dioxide is evaporated by heat alone and by heat and reduced pressure respectively.

The present process consists in evaporating the sulphurous acid in several stages, in arranging suitable cooling and condensing of oil from the acid vapours, thus recovering the maximum amount of sulphurous acid for re-employment without further treatment in a continuous process with the least expenditure of energy.

The oil for treatment is cooled in a heat interchanger and by evaporating liquid sulphurous acid, then enters a mixer by a supply tube through a valve controlling the quantity of oil introduced. The requisite quantity of previously cooled sulphurous acid is conducted to the upper part of the mixer under pressure.

In the mixer the oil introduced at the bottom ascends, whilst liquid sulphurous acid introduced at the top descends, and carries with it in solution the aromatic hydrocarbons from the oil. The washing is progressive, continuing from below upwards. Extracted oil and acid mixture are led to separate tanks from which they are withdrawn by pumps, preheated and led to evaporators, where the evaporation of the sulphurous acid from the two mixtures proceeds continuously in any desired number of steps in order to obtain complete removal.

The first stage of evaporation is by the action of heat alone, in the next successive stages by the combined action of heat and reduced pressure, and in the last stage preferably by the application of a comparatively high vacuum, so that the gases evolved in the first stage flow into the condenser tank by their own pressure, while the gases evolved in each successive stage are raised respectively to the pressure of the condenser tank by means of compressors.

The sulphur dioxide gases are cooled to about 5° C. in order to condense any low boiling oil vapours and then returned to the condenser tank and from thence into the cycle of operations again. H. S. G.

538. Refining of Hydrocarbon Oils. E. B. Phillips and J. G. Stafford. U.S.P. 1,639,531. Aug. 16, 1927. Appl., Oct. 22, 1924.

A method for refining and distilling hydrocarbon oils, and relating more particularly to the treatment of petroleum distillates which have been subjected to refining by sulphuric acid.

In sulphuric acid refining neither neutralisation nor washing are usually sufficiently complete to remove all acidic compounds. These decompose on distillation and recombine with unsaturated compounds causing discoloration.

The present method provides a means of refining by which can be obtained a product of good colour without the removal of unsaturated constituents.

Hydrocarbon oils are distilled and subjected to treatment with an alkali whilst undergoing refluxing in a tower from which the reflux is returned to the still in which the distillation is effected. The alkali introduced into the reflux tower is brought into intimate contact with the liquids and vapours in the tower, the oil being subjected to treatment with alkali for a prolonged period.

The alkali may be introduced into the reflux tower as an aqueous solution or suspension, or as an emulsion with all or part of the oil subject to distillation, to assist and promote distribution of the alkali in the tower.

In further treating sulphuric acid refined oils the alkali combines with any acidic constituents liberated by decomposition of such bodies in the oil, including sulphur dioxide, to form stable compounds. Objectionable reactions between such bodies and unsaturated compounds is inhibited and discoloration avoided. Further, the alkali protects the reflux tower from corrosion.

The amount of alkali added is regulated so that the residual oil is only just alkaline, by which means the reaction product of the alkali treatment are withdrawn in suspension with the residual oil and no deposits are left on the surface of the interior of the still.

The process is of special value and application in redistilling light oils and distillates for the separation of a finished product without further refining, particularly where such oils or distillates have previously been subjected to chemical treatment. H. S. G.

See also Abstract No. 578.

Lubricating Oil and Wax.

539. Arizona Halloysite suitable for Clay Pulp Contact Filtration. H. L. Kauffman. *The Refiner*, Aug., 1927.

The essential features of contact-filtering lubricating oils are given and set out in the order in which the steps are carried out :—

1. The oil is re-acid-treated, using such an amount of acid that will give a reduction in the colour of the oil at a cost that is less than that of filtering to a similar colour.

2. The oil is withdrawn from the agitators and the tar settled out.

3. The raw clay is treated with sulphuric acid, washed with water, and allowed to settle until it reaches the condition of a slime or pulp.

4. A clay-oil emulsion is prepared by mixing together, in a lead-lined tank, the wet-clay pulp and acid oil in 50–50 ratio.

5. The clay-oil emulsion and the rest of the oil are now delivered by separate pumps into a pipe still wherein it is raised to such a temperature at which a slight tendency of the oil to distil takes place. At this temperature all the water is driven off and the clay has its maximum decolorising and de-acidifying efficiency.

6. The mixture is discharged into a vapour separator, where it is thoroughly steamed.

7. The steamed mixture is passed through a filter press for the removal of spent clay.

8. The filtered oil is passed through coolers to storage. The filter cake may be treated for the recovery of the oil contained therein.

In preparing the treated clay it is first ground to a 200 mesh fineness. The acid solution containing 20 per cent. by weight of 66° Bé sulphuric acid is prepared in a lead-lined cooker. From 0·4 to 0·5 lb. of 66° Bé acid per pound of dry clay is a suitable quantity. The desired amount of clay is transferred into the clay cooker, the mass being agitated during and for some time after the addition of the clay. After thorough mixing exhaust steam is admitted to the jacket, agitation being continued at intervals. After from 4 to 6 hours most of the acid has been absorbed by the clay, forming a pulp that does not require further agitation. The cook is usually complete in 6 to 8 hours, but should be allowed to soak for 18 to 24 hours. The cooker is then filled with water during agitation, and the whole is pumped to a water-wash tank, allowed to settle, and the supernatant liquid pumped off and wasted. After being washed 4 or 5 times at 180° F. to reduce the acidity to a minimum, the clay is allowed to settle until it is as thick as can be handled readily by pumps. The clear water is then drawn off as closely as possible and the remaining pulp pumped to pulp storage.

The writer examined two samples of Halloysite. Halloysite No. 1 was an average sample taken from a 320-acre deposit in which were two ledges of the mineral, the top from 3 to 4½ ft. thick and the bottom from 2 to 3½ ft. thick. This sample disintegrated quickly in water, making grinding unnecessary. It was first dried and screened to 100 mesh before being used. Halloysite No. 2 was an average sample taken from another 320 acre deposit in which the ledge at outcrop was about 6 ft. This sample did not disintegrate in water and had therefore to be crushed and screened before use. Sample No. 1 of 100 mesh was compared in its raw state with Georgia fuller's earth of the same mesh and also after having been given five different treatments as follows :—

1. A sample was washed with four successive portions of 180° F. water, using an amount of water equivalent to a gallon per pound of clay. This is referred to as a "Raw Pulp."

2. Five per cent. by weight of sulphuric acid was stirred into the raw clay, agitating the clay the whole time. To obtain a more intimate mixture this clay was then put through the grinder twice before using. This is referred to as "5 per cent. Dry Acid Treated."

3. A sample was digested for 5 hours at 200° F. with a mixture of 5 per cent. by weight of concentrated sulphuric acid and sufficient water to give a pouring consistency. This pulp was then used without washing out the reaction products. This is referred to as "5 per cent. Acid Treated Pulp."

4. One half of pulp made under 3 was dried at 230° F. and used in filtration tests. This is referred to as "5 per cent. Acid Treated, Dried."

5. Fifty per cent. by weight of 66° Bé sulphuric acid was added to the clay. Enough water was then added to give an acid concentration of 20 per cent., the whole then being digested under reflux condenser for 5 hours at 200° F. The pulp was then washed four times at 180° F., using an amount of water on each equivalent to a gallon per lb. of clay. This is referred to as "50 per cent. Acid Treated Pulp."

The efficiency of a clay is determined by contacting the same oil to the same colour, using different clays. Then taking one clay as unity, the efficiency of the others is readily determined. The clay pulp is added to 200 c.c of oil in a large beaker and heated as rapidly as possible, stirring the whole time. Hold the oil at the maximum temperature until the foam caused by the moisture in the clay has practically disappeared. Filter out the clay as quickly as possible. If temperatures above 300° F. are to be used the mixture should be held at 260° F. until nearly all the foam is off, then transferred to a round-bottomed short-neck flask having a steam line and thermometer extending to the bottom and a vapour vent. Heat to the desired temperature as rapidly as possible, shaking the flask during the operation. Turn in a little steam at 280° F., and steam down from the maximum temperature to 300° F. Continue cooling without steam to 250° F. and filter.

The results of these comparative filtration efficiencies between this No. 1 sample of halloysite and 100 mesh Georgia fuller's earth are as follows :—

1. The untreated halloysite is less efficient than fuller's earth, and therefore not economical for use.

2. The "raw pulp" was less efficient than the dry halloysite.

3. The "5 per cent. acid treated pulp" is more efficient than the untreated clay. In the best case the efficiency was 4·0, fuller's earth being unity.

4. Both the "5 per cent. dry acid treatment" and the "5 per cent. acid treated dried" showed no greatly appreciable increase in efficiency over the untreated clay, though the comparison was only made on one oil.

5. The "50 per cent. acid treated pulp" was by far the most efficient of all the methods of treating, showing an efficiency of 10 times that of fuller's earth on a neutral cylinder stock; 9·4 times on a California asphaltic base neutral oil; 6·0 times on Pennsylvania paraffin base neutral oil; and 5·0 times on a long residuum acid stage.

Halloysite No. 2 was ground and screened to 100 mesh fineness, and tested in the "raw" and in the form of a "50 per cent. acid treated pulp." The method of treating the clay was similar to that for No. 1 sample, except that wash-water to the equivalent of ¼ gallon per lb. of clay was used. The relative filtration efficiencies of the raw clay and the acid treated pulp compared with fuller's earth were determined on 3 oils, a cylinder stock residuum, acid stage; a lubricating distillate, acid stage; and a medium motor oil, neutral. A summary of the results shows :—

1. The untreated clay is less efficient than fuller's earth.

2. The "50 per cent. acid treated pulp" showed an efficiency of 5·7 times that of fuller's earth on a cylinder stock, acid stage; 6 times on an asphalt base lubricating distillate, acid stage; and 10 times on a neutral motor oil.

S. W. C.

540. Contribution to the Study of Lubrication—Oiliness, Molecular Influences. By Paul Woog, Prof. at L'Ecole Nationale Supérieure du Pétrole Univ., Strasbourg.

In his introduction the author comments shortly on the conditions of lubrication of the moving parts of a machine. After having pointed out that perfect lubrication depends simply on the laws of hydrodynamics, he deals chiefly with imperfect lubrication, a much more frequent condition, although little understood, and in which the oiliness of a lubricant is of the utmost importance. The oiliness results in a number of phenomena which, influenced by the solid surfaces, stabilises a lubricating film and reduces friction. The more permanent is the oily pellicle interposed between the surfaces, and the easier the slippage, so is the oiliness more marked. This property of lubricants differs essentially from viscosity in as much as it can only be manifest as a part of a solid surface. Hence, the study of phenomena in relation to oiliness can be devided logically into two groups:—(1) Reactions due to lubricants in the presence of solid surfaces; and (2) Reactions attributable to solid surfaces, owing to their particular nature.

1. In the first group, after having rejected the interference of superficial tension (lubricant-air) and indicated briefly the mechanism of the covering of solid surfaces by lubricants (interfacial tension and adsorption), the author studies the rôle played by the coincidence of the molecules in the resistance of the lubricating film in contact with the solid (epilamen). This epilamen yields to compression or tangential strains, and resists the disturbances which threaten it. It preserves the entireness of the surface by means of the mutual support given by adjacent molecules. This coincidence can manifest itself in two ways:—In the first case, the actions between the molecules are of a geometrical order; they depend essentially on the volumes of the molecules, and the phenomena ceases with the motive which has promoted it. In the second, the coincidence results from the dynamic properties, but it is of a rather special nature, for according to the limit of its manifestations, it produces irrevertible or revertible results. The author examines this complex case, in which the structure and the nature of the molecules play an important rôle, and he deals successively with the different points which, according to him, have an influence on the peculiar dynamic properties previously considered. (*a*) The dimensions of the molecules, and the influence of their form and orientation have their importance, for if the molecules were in an irregular layer, this thin lamina would be of little resistance, whilst a layer of regular and symmetrical texture would possess the greatest stability. The author gives details of a very precise experimental study of the properties of the constituent molecules, and shows particularly the important rôle played by active groups (polar or non-polar) in the resistance of films. (*b*) The resistance of the films is augmented by the adherence of the lubricant to the solid bearing. This surface attraction of the active atomic groups of the lubricant is made evident in various ways by the author, who describes numerous experiments dealing with the extension of oils on liquid and solid surfaces. It is interesting to note that in the case of a solid surface the active centres of the lubricant have an inverse action to that of a liquid surface. The extension of oils on the rigid surface is inversely proportional to the number of active centres. (*c*) The molecules possessing a certain "elastic rigidity" are more capable than the others of mutual support, and in conse-

quence give a more resistant film. The author estimates that in the multiple carbon bond molecules the non-satisfied volencies, which we know can contribute to the fixation of films, are on the other hand a cause of weakening of the molecular frame. This point of view is confirmed experimentally by the study of the stability of emulsions, of the resistance to rupture and lateral compression, and the equilibrium of the monomolecular position of different bodies suspended in the water. (P. Woog. *Comptes rendus de l'Académie des Sciences* 177, 1923, p. 1107.) These experiences are in direct agreement with the phenomena which have their origin in the films met with in practice. The author has had the opportunity of studying the testing carried out on lubricating oils in industrial laboratories. He indicates various causes of error, and indicates interesting improvements augmenting the precision of the methods generally adopted. (*d*) The viscosity relates to the oiliness only when the stability of the film is menaced or compromised. The disturbances are in effect better resisted, so that "elastic waves" coming from the exterior or issuing from the film are deadened more quickly. A high viscosity is therefore favourable to oiliness, for it preserves the film due to this oiliness.

II.—The second part of the work deals with the actions attributable to solid surfaces. It is inferred that for the phenomena of affinity between lubricant and solid, the attraction due to the molecular qualities of the lubricating liquid can be increased or restricted by the forces which act at the surfaces of the solids.

The practical application of the theories enunciated in the course of the work are very numerous, and the author gives some chosen examples of them. The results obtained nearly always allow of a precise statement of the characters to look for in the improvement of lubrication in the most powerful machines, as well as in the most delicate apparatus (chronometry). For the last in particular, entirely new procedure has been indicated.

This work, the most complete in our possession dealing with oiliness, is to be recommended in addition, for its extremely valuable and frequent references, and it must be remembered that Mr. Woog has singularly advanced the problem. The hope which he expresses at the end of his book that very soon the "art of lubrication" will be transformed into the "the science of lubrication," is already realised in a very remarkable manner by himself. X. N.

541. Crystallisation of Paraffin Wax. F. Rhodes, C. Mason and W. Sutton. *Ind. & Eng. Chem.*, **19**, 8.

Investigators have shown that paraffin waxes crystallise out of solvents in plates or needles. Similar crystals have been found when melted wax has been allowed to crystallise. In the present paper an attempt was made to find the relationship, if any, which existed between the two types of crystals.

The wax used was slack wax from Pennsylvanian crude. The wax was sweated in the laboratory, six fractions being obtained. The molecular weight and melting points of each fraction were determined. Except in the case of the first fraction the melting points and molecular weights increased for each successive fraction. The molecular weights of fractions 5 and 6 were practically identical, although the melting points varied by almost 3° C. This seemed to indicate the existence of a mixture of isomeric paraffins in these two fractions.

The molecular weights were determined by the cryoscopic method, using naphthalene as a solvent. The behaviour of each fraction on solidification was studied under the microscope. The samples were melted and their rates of cooling carefully controlled by means of an electrically heated hot plate. All the fractions behaved in the same manner except for the fact that the

temperatures at which the corresponding changes took place varied with each fraction.

In all cases crystallisation commenced in the form of plates. If the cooling was rapid (more than 0·1° C. per minute) the small plates seemed to curl at the edges and roll up, forming long needles; the larger plates remained, giving a conglomerate of large plates and needles on complete solidification. Very slow crystallisation gives large plates. No indication of these two forms being allotropic modifications of the wax could be found as if the cooling was arrested no change in the proportion of needles to plates seem to take place.

K. B. R.

542. Dewaxing Paraffin Base Crude Oils. H. M. Smith. *Oil & Gas J.*, Sept. 15, 1929.

Acetone may be used for the separation of waxes and oils, but as 80 times as much acetone as oil has to be used it is unsuitable for large scale work. Isopropyl alcohol and secondary butyl alcohol were tried; the former was found to be useless unless it was dehydrated with caustic soda and copper sulphate. Preliminary experiments were carried out with these two substances using acetone as a standard. The propyl alcohol was found to be rather less efficient than acetone and the butyl alcohol rather more so; therefore, further experiments were confined to the butyl alcohol. It was found that cold settling was the most convenient way of effecting the separation.

A number of solutions of oil and butyl alcohol and oil, butyl alcohol and acetone were tested for their efficiency. It was found that the proportions 1 : 1 : 1 and 3 : 4 : 2 of oil, butyl alcohol and acetone gave the best results, the latter ratio giving slightly better results.

An experiment on a fifty-gallon scale was carried, using these ratios. An oil with an original pourpoint of 25° F. gave a pourpoint of 15° F. after treatment. The loss of oil was 1·5 per cent. No figures are given about the loss of solvent.

K. B. R.

543. Heat of Solution of Paraffin Wax. F. W. Sullivan, W. J. McGill and A. French. *Ind & Eng. Chem.*, **19**, 9.

The heat of solution of paraffin wax (m.p., 125° F.) in pressed mid-continent wax distillate and gas oil was found to be 72·5 B.T.U.'s per lb. The wax was stirred in the oil in a calorimeter placed in a stirred water bath, the temperature of which could be controlled by the addition of hot or cold water. A thermometer reading to ·2° C. was placed in the oil, together with a nichrome heating coil which served to bring the oil to a desired temperature, and was also used in finding the water equivalent of the calorimeter.

In making a determination the water bath and oil were brought to the same temperature, and a weighed sample of wax in a suitable shredded state was introduced. Temperature readings were taken at 50-second intervals, until no change was observed over a period of 200 seconds. As the oil temperature fell the bath was adjusted to the same temperature by means of the control taps.

Similar procedure was adopted for obtaining the water equivalent, a definite amount of heat being supplied by the electric heater.

The temperatures used for solution were about 50° C. for the wax-distillate and 30° C. for the gas oil.

P. D.

544. Lubricating Oils as Insecticides in Dormant Spraying. E. L. Green. *Ind & Eng. Chem.*, **19**, 9.

Petroleum products are most suitable insecticides owing to impunity with which they are handled by man. They appear to enter through the skin of the insect and are not inhaled or swallowed. Where the destruction of

insects is carried out in a confined space the lighter fractions of crude petroleum are used, but in open spaces like orchards lubricating oils appear to give the best results.

The results of a series of experiments on the toxicity of lubricating oils is given in this paper. The oils were used in the form of an emulsion, a potash fishoil soap dissolved in crude cresytic acid being used as the emulsifier.

The tests were carried out on orchards infested with San Jose scale and leaf roller. All spraying was carried out in the early spring before any foliage is exposed. As lubricating oils are fairly inert chemically it was assumed that their toxicity was due to a physical rather than chemical effect, thus the constants of each oil determined were the specific gravity, viscosity and distillation in a specially designed apparatus.

Oils were obtained from various companies. As it had previously been shown that refining the oils did not increase their toxicity "neutral" oils were used except in cases of white lubricating oil and gas oils. The investigators arrived at the following conclusions:—

Viscosity has no direct bearing on toxicity. An oil which had been diluted with kerosene gave no better results than when it was used undiluted.

It was found that oils containing large fractions distilling between 240—300° C. under 40 mms. of mercury pressure were more toxic than others.

The two waterwhite lubricating oils were found to be very toxic. As these oils had been subjected to a heavy sulphuric acid treatment only very small amounts of unsaturated hydrocarbons could have been present, which seems to show that the saturated hydrocarbons are effective in killing insects.

No distinction could be drawn between paraffin or asphalt base oils. Two gas oils were tested; one contained some lubricating oil, while the other contained none. The former was found to be superior as an insecticide.

K. B. R.

545. New Researches upon Insulating and Lubricating Oils. Heyd. *Chem. et Ind.* May, 1927, p. 770.

The only effect of oxidation upon an insulating oil is to lower its insulating power; the lowering of the dielectric resistance is due only to the humidity of the oil. Kissling's index of resinification does not estimate accurately the change in insulating power caused by oxidation, or the attack on the insulator by the altered oil. Oiliness and viscosity are the most important properties of lubricating oils. The latter depends to a large extent on temperature, but the less the influence of temperature, the better the lubricant. The former is determined by consistency and thickness of the film adhering to the metal surface. Oiliness depends upon the presence of "active groups" (–COOH and —OH) or of unsatisfied valencies. Oiliness affects friction between liquid and solid while viscosity affects friction between liquid and liquid. The effect of progressive oxidation of oils has been studied, and it is proposed to augment physical tests by "refractolysis." This consists of following volumetrically and refractometrically the bi-phase reaction between the lubricant and an appropriate reagent (*e.g.*, H_2SO_4). The decrease in volume indicates the quantitative relation between the constituents of the oil, while the refractometer reading gives qualitative information. Illustration of this method is by two practical examples. The importance of absorption spectra in estimating the quality of oils is emphasised.

W. H. T.

546. Solubility of Paraffin Wax in Oil. F. W. Sullivan, W. J. McGill, and A. French. *Ind. & Eng. Chem.* Sept., 1927.

A knowledge of the solubilities of paraffin wax in petroleum oils at various temperatures and of the effect of viscosity of solvent and the melting-point of

the wax upon solubility is of considerable practical value in filter pressing wax distillates to remove the wax.

The waxes used in these experiments were fractions from the vacuum distillation of 50 litres of 125° F. melting-point wax obtained from the refinery. This had been sweated from intermediates and consequently did not contain the highest melting-point waxes separated in pressing. A vacuum of 5 mm. was maintained on the still throughout the distillation. Five distillations of 10 litres a time were made, and from these the 0–20 per cent., 20–40 per cent, 40–60 per cent., and 60–80 per cent. cuts were combined to give 10 litres of material for the second fractionation. The 80–90 per cent. cuts combined gave another 5 litres. Thus 5 more distillations were made, 10 per cent. cuts being taken again, representing 2 per cent. of the total wax charged. Since at about 125° F. melting-point the melting-points of the cuts were closer together than at the very beginning or at the end of the distillation, a selection of cuts was made from the second fractionation and distilled in a 5-litre vacuum still. From these cuts an amount of quite pure 125° F. melting-point wax was prepared. A sample of 111° F. melting-point wax was made by a recrystallisation of twice-distilled low melting-point cuts from ethyl methyl ketone. A sample of 145° F. melting-point wax was selected from the higher melting fractions of the second fractionation. The boiling-point range of these fractionated waxes was 5° C. at 5 mm. pressure.

To study the solubility of these various waxes it was necessary to obtain oils that were practically free from paraffin wax and also oils in which the wax occurs in the plant. An amount of ordinary pressed distillate was repressed to a cold test of –20° F. Ten litres were then distilled at 5 mm. pressure taking 10 per cent. cuts. These fractions were clear and fluid at 0° F., and hence were considered to be wax free. A blend corresponding to a 15 per cent. bottom f om this distillation had a viscosity of 420 Saybolt seconds at 100° F., and could not be improved in colour by claying. It was therefore redistilled to a small bottom and an oil of good colour and 333 viscosity obtained. The following solvents were used :—

(1) Petroleum ether. (B.P. 21·0° to 82·0° C.)
(2) 34 viscosity oil obtained as a bottom in re-running heavy naphtha.
(3) 36 viscosity oil from fractional distillation of a wax free pressed distillate.
(4) 75 viscosity oil from same source.
(5) 191 „ „ „
(6) 71 viscosity wax free pressed distillate, not fractionated.
(7) 45 per cent. bottom from pressed distillate diluted to 46 viscosity with 34 viscosity heavy naphtha bottoms.
(8) 65 per cent. bottom from pressed distillate diluted with 15 parts of heavy naphtha bottoms ; viscosity 71.
(9) 333 viscosity oil obtained by redistillation of 20 per cent. bottom from fractional distillation of wax free pressed distillate.

In determining the solubility it was decided that since the waxes were closely cut fractions the cloud temperature would indicate the point at which the wax in question saturated the solvent. The wax solution was placed in a test tube with a chill test thermometer and glass stirrer, stirring being effected mechanically. The test tube was immersed in water for cloud points at higher temperatures, and in a metal jacket in an ice and salt bath for lower temperatures. For very low cloud points brine at –25° F. was used as a cooling medium. In general results could be duplicated within less than 1° F., but the cloud point was not so definite at the lower temperatures, particularly in the case of viscous oils. The cloud points of the maximum concentrations of the solution used were in general below 75° F. Solubility determinations

were made at 8 different concentrations—between 0·25 and 3·5 per cent. with as high as 6 per cent. in a few cases—of each wax in each solvent, and curves drawn. From these curves others have been drawn showing the effect of viscosity upon solubility at various temperatures, and the effect of the melting-point of the wax upon its solubility in the various solvents at different temperatures. The following conclusions were drawn from the results :—

(1) The solubility of paraffin waxes increases as the melting-point of the wax decreases.

(2) The solubility of paraffin wax in petroleum oils decreases with increasing viscosity of solvent.

(3) Differences in solubility due to differences in the melting-point of the wax or to variations in the viscosity of the solvent decrease with decreasing temperature.

Attempts to develop a useful mathematical expression of the rate of change of solubility with changes in the melting-point of the wax or the viscosity of the solvent have not been successful. S. W. C.

547. Suggestions on the Manufacture of Steam Refined Cylinder Stock. B. Kalhoff. *The Refiner*, July, 1927.

The advent of improved manufacture of lubricating oils has resulted in the abandonment of the use of cylinder oils in a great many cases, but despite this fact there is still a market for such oils.

Cylinder stock should be kept as near the colour of the original crude as possible ; *i.e.*, cylinder stock representing, say, 20 per cent. on the crude when mixed with four times its volume of petrol should nearly match the crude in colour. As a light coloured stock is more saleable, it is an advantage to select a crude which will insure this property in the finished product. By suitable selection of crude it is also possible to dispense with preliminary chemical treatment.

All light distillate and as much wax as possible must be removed in the manufacture, steam being used in the last stages of distillation. The use of the correct amount of steam is the chief difficulty, but when doubt exists it is better to be wasteful rather than to run the risk of cracking the oil by using too little. K. B. R.

548. Valuation of Lubricants. *Chim. & Ind.*, May, 1927, p. 780.

The article gives a list of the desirable properties of lubricating oils, summarises methods of analysis, and indicates some practical methods for detecting the presence of acid :—(1) A sample of oil mixed with cuprous oxide becomes blue or greenish-blue after about 20 minutes if acid is present. (2) Drops of cylinder oil placed on a sheet of copper give a green precipitate after 5 or 6 days if acid is present. The best test of an oil is to use it for 3 or 4 days in the cylinder, after previous cleaning of cylinder, piston and lubricator. At the end of the test all the parts should be bright, covered with oil and free from deposits of carbon, etc. W. H. T.

549 Apparatus for Regulating Wax-Sweating Systems. S. S. Amdursky. U.S.P. 1,636,730. Aug. 26, 1927.

In this paper a method is described for sweating wax. The plant consists of the sweating house in which are the trays. These are fitted with gauze at the junction between water and wax. The space occupied by the wax is fitted with a number of water-pipes. The crude wax is poured into the tray and allowed to solidify, cold water being run through the pipes. Then the doors of the sweating house are closed and the house itself heated up by means

of radiators which have an automatic temperature regulator. Hot water is also passed through the pipes in the body of the wax. At the beginning the temperature of the room is 10° F. above that of the water in the coils, but as both increase they approach until at the end the room temperature is only two or three degrees more than the water in the coils. The control of the temperature of the atmosphere of the sweating house and the heating coils is automatic. K. B. R.

550. Art of Decolorising, Clarifying and Purifying Petroleum Oils. H. L. Kauffmann and J. A. Clark. U.S.P. 1,636,938.

A form of apparatus is described for treating lubricating oils with clay. The clay is thoroughly mixed with from 30 per cent. to 500 per cent. of its own weight of water. This suspension of clay in water is pumped into an agitator, where it is thoroughly mixed with the oil to be treated (in most cases this oil has been acid treated) by means of paddles.

From the agitator the mixture of oil, clay and water is pumped through heating coils, the flow through these coils being slow enough to allow the mixture to attain a temperature somewhat below the boiling-point of the oil. The heating coils discharge into a vapour separator in which the steam and vapours pass through an overhead line while the oil collects on the bottom. Steam is injected into the bottom of the vapour separator until the oil has cooled down to about 110° C., when it is run into a tank for further cooling before filtering or centrifuging to remove the clay.

The authors state that the reason for the good results obtained by this method of treatment may be that the escaping steam leaves the clay in a porous, and thus more active, condition. It has been found that the addition of certain materials, such as zinc chloride, enhance the reactivity of the clay in this process. The catalyst is believed to polymerise the asphaltic tarry matter and thus make it more easily absorbed by the clay. K. B. R.

551. Apparatus for Purifying Used Mineral Lubricating Oil. R. E. Langston. U.S.P. 1,640,415.

The apparatus consists of a jacketted vessel fitted with a steam coil. The jacket is filled with oil which is heated by gas; some type of temperature regulator being fitted. The oil is heated to a high enough temperature to drive off all the volatile products in the oil, steam being introduced to facilitate the removal of these substances.

The oil is then allowed to cool, and when it has dropped below 212° F. a suitable solution of sodium carbonate is added to coagulate the carbon and dirt in the oil. The mixture should be well stirred. Water is then introduced slowly into the bottom of the container, and the clarified oil flows out by a suitably arranged overflow pipe. K. B. R.

552. Lubricant for Automotive Engines. L. B. Lockhart, assr. to Standard Oil Co., Indiana. U.S.P. 1,639,347. Aug. 16, 1927. Appl., Feb. 20, 1926.

A lubricant particularly adapted for use in cold weather, facilitating starting and lubrication of the bearings, and suffering little or no loss of viscosity by dilution, has a viscosity of not less than 140 seconds Saybolt at 100° F., a flashpoint in excess of 110° F., and on distillation yields 5 to 15 per cent. of fractions boiling above 300° F. and below 460° F.

A preferred oil in accordance with the invention is one having a viscosity of about 184 seconds Saybolt at 100° F., a flashpoint of about 150° F., and containing about 8 per cent. of fractions boiling between 320° and 450° F. Such an oil may be produced by mixing about 8 parts of a light distillate oil

having a boiling range of 320° to 460° F. with 92 parts of a viscous lubricant of paraffin type or mid-continent oil, having a viscosity of 340 to 350 seconds Saybolt at 100° F. H. S. G.

553. Process of Purifying Hydrocarbons. L. W. Parsons and S. P. Coleman. U.S.P. 1,640,720. Aug. 30, 1927.

The patent describes a method of refining heavy mineral oils, and in particular lubricating oils. The method comprises adding 1 to 10 per cent. of copper oxide to the oil, and heating to a temperature below that of vaporisation for 15 to 30 minutes, while agitating. The oil is then introduced into a still containing a charge of caustic soda amounting to 2–8 per cent., and distilled. The treatment with copper oxide may be preceded by one of sulphuric acid, where required. W. H. T.

See also Abstracts Nos. 557, 562, 569 and 601.

Special Products.

554. Chemical Processes for Re-refining and Decolorising Dry-Cleaners' Solvent by Continuous Automatic Methods. A. E. Flowers, F. H. McBerty and M. A. Dietrich. *Ind. and Eng. Chem.*, August, 1927.

Dry cleaning consists essentially in washing textiles in a suitable non-aqueous "solvent." In the process which is almost universally used, the goods are washed with gasoline in a laundry type washer. Most of the excess solvent is then "extracted" by centrifugal force, and finally the last portion of the solvent is evaporated by the use of air at about 80° C. in a drying tumbler. Petroleum hydrocarbons used for dry cleaning should conform to the following general requirements:—

1. The solvent should not affect the strength, flexibility, smoothness or lustre of the textile fibre.
2. The solvent should not alter the dyestuffs used.
3. The solvent should not be injurious to plant workers.
4. The solvent should have a high initial boiling point to minimise evaporation losses and particularly the fire hazard.
5. The solvent should have a reasonably low end point to facilitate the removal of the last traces of solvent in drying.
6. The solvent should be free from coloured or odorous constituents and from suspended solids or moisture which might be retained by the goods.

The first three of these requirements are apparently filled by any of the properly refined petroleum distillates. The requirements of high initial and low end point are not met by ordinary motor gasoline. An effort is being made to promote the use of the so-called Stoddard-type solvent, which reduces evaporation losses and fire hazard without sacrificing ease of drying. This type of solvent has a flash point (Cleveland open cup) between 40·6° C. and 43° C. Distillation curves showing the difference between this type of solvent and winter grade motor gasoline are given.

The removal of dirt, moisture and colour from the solvent, and the elimination of any odour which might be retained by the goods are the dry-cleaner's most difficult problems. The modern cleaner demands that the solvent in the washer be dry, fairly clean, light coloured, and free from objectionable odour at all times; and, further, that the solvent condition at the end of the washing period be such that no rinsing is needed. On the average 100 kgs. of goods cleaned yield 1·6 kgs. of dry, solid dirt, and about 1·8 kgs. of high boiling substances soluble in the cleansing fluid. The presence of

small amounts of suspended solids or even of "dirt" in the cleansing fluid is not necessarily objectionable. Even fine white silks may safely be washed in solvent containing appreciable amounts of dirt, if no free moisture is present. If, however, the solvent contains as little as 0·1 per cent. (by volume) of free water, a large part of the dirt and moisture is picked up by the goods causing spots and general discoloration.

Tests indicate that the large amounts of unsaturated hydrocarbons contained in present-day motor gasoline may be responsible for some of the colour and odour formed when this solvent is used. Both colour and odour may be removed by treatment with concentrated sulphuric acid. The new Stoddard type solvent is practically free from unsaturated compounds, and does not appear to develop appreciable amounts of either colour or odour spontaneously, even when exposed to air in the presence of alkalies. The results of an examination of a 1926-27 winter motor gasoline and of a Stoddard type solvent by the method of Egloff and Morrell are :—

Hydrocarbon.	Stoddard Solvent.	Motor Gasoline. (1)	Motor Gasoline. (2)
	%	%	%
Unsaturates	0·5	6·5	7·0
Aromatics	7·3	7·2	4·4
Naphthenes	4·7	28·7	22·4
Paraffins	87·5	57·6	66·2

The removal of suspended solids and moisture from the used solvent can be cheaply and effectively carried out by the centrifugal clarifier. Distillation is perhaps the most obvious means for purifying contaminated solvent and batch distillation by the use of open steam appears to be the accepted procedure. But distillation cannot remove volatile substances, nor does it remove the varnish-like odour commonly found in used motor gasoline, and the distilled solvent may also contain substances which cause it to cling tenaciously to traces of moisture after separation.

Continuous clarifying and decolorising systems are gradually replacing the batch methods. While the cleaner who relied upon batch method of contamination removal uses the solvent until its colour is 250 or more, the cleaner who operates a continuous system uses solvent whose colour varies only between 20 and 60. A continuous process must therefore handle many times the volume of solvent that would be handled by a batch system washing the same quantity of goods. Consequently the cost of processing a litre of solvent must be very low and preferably vary with the amount of contamination removed. Steam distillation is far too costly for use as a continuous decolorising process. Chemical processes therefore came into use. The first to come into general use consisted in washing the dirty solvent with a caustic soda solution and then with water. This, however, did not prevent the slow accumulation of colour and odour. In 1924 the use of certain types of activated carbon in conjunction with aqueous alkaline solutions came into use. Laboratory tests indicate that this process will not entirely remove the varnish-like odour from used solvent, and there is some indication that gradual accumulation will take place in continuous systems using this process in conjunction with motor gasoline. Numerous attempts have been made to utilise Fuller's earth and the newer activated earths for decolorising used solvent. But the relatively large quantities of such decolorising agents required and the considerable loss of solvent involved, together with the necessity for proper control of moisture content, more than compensate for the simplicity of equipment and process involved. The regeneration of exhausted earths, as practised in the petroleum industry, does not appear to be feasible under the conditions of the dry-cleaning plant.

An experimental plant was set up for testing these various processes. Work was first carried out using activated earths, but this was soon abandoned as being too costly. Then sulphuric acid was used as a decolorising agent. Acid-treated motor gasoline has a high end point which produces difficulty in removing the last traces of solvent from the goods in the drying operation. Acid-treated Stoddard type solvent does not produce this difficulty. Further, it was found that the treated solvent may contain traces of acid tar and reaction products. These may be removed by washing with water or alkaline solutions, but emulsification is likely to result if sufficient agitation is used to ensure complete reaction. It was discovered that such difficulties could be avoided by using neutralising solutions containing aqueous ammonia. The effectiveness of such ammoniacal solutions appears to be due to a slight solubility of ammonia in the hydrocarbon liquid. This is an advantage, in that the odour of ammonia in the washer indicates that the neutralising solution is functioning properly. The present units for decolorising used cleaners solvent by means of sulphuric acid are designed to receive continuously from the centrifugal clarifier used solvent of a colour of not more than 100 at a rate of 500 litres per hour, and to deliver to the centrifugal clarifier, and through this to the washer, this stream of solvent decolorised to between 0 and 20, depending upon the condition of the acid charge. S. W. C.

555. Comparison of Qualities of Asphalts of German and Mexican Origins. L. Rosner. *Petroleum*, 1927, **23**, 609—610.

The asphalts obtained by distillation in a pipe still, without vacuum, at 400-420° C. of two crude oils (a German Elwerath crude and Mexican crude of Panuco type) were compared. The respective properties of the crude oils were: sulphur content, 0·55—5·8 per cent.; sp. gr. at 15° C., 0·918—0·986 per cent.; paraffin wax content, 1·2—0·2 per cent.; and asphaltum insoluble in benzine, 0·1—16·4 per cent. The asphalt from Mexican crude is a more valuable commercial product, as having higher drop point (Ubbelohde), and lower penetration and breaking point. The respective yields of asphalt of the two crudes were 8·00—50·60 per cent. and 6·50—45·50 per cent. Petroleum asphalt is better for road-making than any asphalt from coal-tar products. The import of asphalt in the finished form is not remunerative, owing to packing difficulties. H. M.

556. Gas Oil-Fuel Oil Blends to Make Road Oil. H. L. Kauffman. *The Refiner*, Aug., 1927.

From an economic standpoint it is advantageous to make road oil by blending together gas oil and fuel oil. The gas oil may be a cut obtained from the primary distillation of the crude, from the distillation of unfinished distillates or the bottoms obtained from re-running pressure distillates. The fuel oil is usually the residuum from the distillation of asphaltic or mixed base crudes. The percentage proportion in which they must be blended together depends upon: (1) the nature of the physical tests on the two individual constituents of the finished road oil, and (2) the particular grade of road oil desired. Since road oils are classified according to the percentage of asphalt of "100 penetration" contained therein, it follows that the percentage of asphalt contained in the original fuel oil has much to do with the percentage proportion in which they are blended.

The article deals with results of experimental blends made with heavy residuum obtained from Simpson Ridge crude oil and gas oil "bottoms" from the re-running of Dubbs pressure distillate. The crude is 23° A.P.I. gravity, and is purely asphaltic in its characteristics. The fuel oil used

in the blends was bottoms from this crude after a maximum quantity of the lubricating oil fraction had been distilled off overhead by combined fire and steam. This fuel oil had the following physical characteristics :—

Gravity °A. P. I.	13·6
Flash °F.	565·
Fire °F.	655·
Saybolt Universial Viscosity @ 210 °F.	1002·
Per cent. asphalt of 100 penetration	96·8

The gas oil showed the following characteristics :—

Gravity °A. P. I.	31·9
Flash °F.	205·
Fire °F.	225·
Saybolt Universal Viscosity at 100° F.	Not taken.

In making the tests seven experimental blends were made in which the percentage of gas oil was increased and that of fuel oil decreased by 12·5 per cent. The physical constants on the blends were obtained and are tabulated. It was particularly desired to know the asphalt content of each blend, as the grades of road oil in greatest demand are those containing 60 or 70 per cent. of asphalt of 100 penetration. The per cent. of asphalt of 100 penetration was determined on the fuel oil, and on those blends in which 87·5 and 75·0 per cent. of fuel oil was present. Because these results checked so closely with a "calculated" determination, the content of the other blends was found by calculation.

The results show that if curves representing the gravity and asphalt content of each blend were plotted, they would approach a straight line; while this would not be true of curves representing flash, fire and viscosity of the blends. Furthermore, those blends in which were present fuel oil and gas oil in the ratios of 75—25 and 62·5 to 37·5 are the ones that might be considered as being most satisfactory as road oils, for the former shows an asphalt content of 72·6 per cent. and the latter 60·5 per cent. S. W. C.

557. Greases and their Manufacture. G. W. Cupit, Jr. *The Refiner*, Aug., 1927.

The same general type of apparatus for grease making is employed by nearly all plants, and consists of a steam jacketed kettle with a draw-off valve at the bottom and a rotating paddle just clearing the bottom of the kettle; above the kettle there should be independent charging lines for adding mineral oil, fat or fatty acids, water and base. Greases in general contain the following components: (1) Fats. (2) Fatty acids. (3) Base (salts of sodium, calcium or lead). (4) Mineral oil. (5) Water—and each component has its particular function.

The fats may be of either animal or vegetable origin, depending on the nature of the grease desired. The fat, together with the base, tends to form a soap which will readily emulsify with mineral oil, and on the addition of the right amount of water will remain as a permanent emulsion. Fats possessing high iodine values make unstable products which soften and darken on the surface when exposed to sunlight. In cases where liquid vegetable fats are used, those possessing hydroxyl groups produce soaps which will scarcely emulsify with the mineral oil.

Free fatty acids form stable soaps which emulsify readily with mineral oil. A slight excess of free fatty acids in a soap will lower the consistency and melting point of the grease. In cases where animal fats and fatty acids are used, glycerine is thrown out of the fats and, like water, tends to throw

the soap formed out of a gel, hence its presence is detrimental. If present in small amounts, however, an emulsion will form with much less water.

The function of the base is to form a soap which, when mixed with the mineral oil and water, will give a uniform and permanent emulsion often referred to as a gel. In the case of lime, the calcium oxide content should be as high as possible and the magnesium oxide content as low as possible, whilst there should never be more than a trace of iron, aluminium, carbonates and silicates. A satisfactory method for the preparation of slaked lime is as follows: a sufficient weight of lime for the preparation of one batch of grease is placed in an iron kettle; warm water is added at intervals in sufficient quantity to prevent the mass from becoming dry; the lime should not be stirred during slaking and water should be 2 or 3 inches above the lime on completion. At this point, by the use of a spatula, the milk of lime may be mixed with the water, but not stirred; then allowed to settle a day or two. After settling the milk of lime should be dipped off the top and screened, care being taken not to disturb the bottom. Drip water from a steam line should be used in order to avoid the presence of chlorides which cause the lime soap and mineral oil to separate.

The nature of the mineral oil used plays an important part in the degree of solubility of a soap and a fully refined paraffin base oil of low viscosity (100 at 100° F. Saybolt) has been found to possess the greatest solvent action on all lime soaps. The greater the viscosity of the mineral oil, the lesser the tendency to hold the soap in solution.

Water is necessary, firstly, in the preparation of the milk of lime, otherwise there would be little or no reaction between lime and fatty acids; secondly, a slight excess of water should be present at all times to prevent the mass from drying and hardening in the kettle during agitation and heating; thirdly, the right amount of water present insures smoothness of the finished product. Only a small percentage of the water added during the process remains in the final grease, and this figure must be determined when finishing the grease. A point that must be remembered is that the addition of much water before saponification takes place causes curds. If such a case arises it is wise to begin over again.

The types of grease made in general are: (1) Cup greases; (2) sponge greases; (3) fibre greases; (4) graphite greases. The formula for a cup grease is:—

100 lbs.	lime.
4 ozs.	organic dye (orange or yellow).
40·5 galls.	hog fat.
40·5 galls.	hoss fat.
19·0 galls.	cotton seed oil (summer yellow).
9·0 galls.	water.
600·0 galls.	light paraffin oil (100 vis. at 100° F. Saybolt).

The organic dye is added to give the desired colour, and the cottonseed oil to give consistency. The mineral oil should first be strained and the dye added. Add the milk of lime to a small amount of the paraffin oil, which would be one quarter of the fats used, and mix well. Call this "Mix A." "Mix B"; mix thoroughly the hog fat, hoss fat and cottonseed oil; pour Mix A into Mix B, and stir by means of a revolving paddle; when well mixed turn on jacket steam gradually and heat uniformly to avoid too much foaming. Maintain at the boiling point until complete saponification has taken place, then raise the temperature until nearly all the water has been boiled off. Add now two-thirds of the remaining mineral oil, heat to 265° F., and add the water slowly. The result will be an emulsion. The remainder of the

mineral oil should be added slowly, in small portions at a time, otherwise the emulsion will cool and therefore harden, necessitating re-heating, which should be avoided. In finishing a grease, after all the mineral oil has been worked in, the longer the stirring is continued below the melting point of the grease, the higher will be the polish and the more the consistency will be destroyed. The grease should be drawn from the vat at approximately 15° below its melting point.

The formula for a sponge grease is as follows :—

1500 lbs. "A" tallow.
5 ozs. organic dye (yellow).
95 galls. caustic soda (30° Bé).
898 galls. light paraffin oil.

To one-half of the melted "A" tallow add the caustic soda, followed by the mineral oil in small quantities, 50 gallons at a time. When approximately half the mineral oil has been added, add remainder of "A" tallow at 210° F. and cook until complete saponification has taken place and most of the water has been boiled off. At this point the batch has balled up into an elastic mass of long interwoven fibres. Slowly work in remainder of mineral oil containing organic dye.

A fibre grease may be made from a sponge grease by prolonged heating at 210° F. at the point at which the mass has balled into long interwoven fibres, when the mass breaks up into short fibres. The consistency may be varied by decreasing or increasing the amount of mineral oil used in finishing the grease.

The formula for a graphite grease is :—

310 galls. light cup grease.
25 galls. light paraffin oil.
125 lbs. fine graphite.

The cup grease and mineral oil are mixed together and warmed sufficiently to make a dilute paste, and while agitation is going on the fine graphite is added gradually, care being taken that the graphite remains suspended, also that the paste is homogeneous after all the graphite has been added. Allow to cool while stirring.

S. W. C.

558. Hard Pitch as the Binding Agent for Carbon Electrodes. Schuchardt. *Brenn. Chem.*, Aug. 1, 1927, 247.

Pitch is not a homogeneous substance, and its investigation for electrodes manufacture presents difficulties. Its suitability for the purpose is not yet clearly related to determinations of softening point, viscosity, etc. The determination of free carbon and asphaltic substances is likely to be full of errors. The coking test is the best for judging a pitch. A portion of the pitch may be squeezed out of an electrode with a small press, placed in a tube open at one end and heated in a smith's forge or a suitable furnace; or, an electrode itself is heated in a retort; if this requires some time the decision as to the usability of the pitch and especially the quality of the finished electrode may be depended upon. The method will also show whether the pitch has been mixed in the right proportion. Even a good pitch will not give good results if mixed in the wrong proportions. The pitch must be low in ash, and hence an ash determination is usually unavoidable.

W. H. T.

559. Production of Contact Substances from the Solar Oil of Grosny. Tilitschejew and Dumskaja. *Petroleumind. russ : Neftjanoe Chozjajstwo*, 11, 738, 1926.

Sulphonic acids formed by the action of fuming sulphuric acid upon solar or machine-oil distillates find technical use as catalyzers of the saponification of fats, in the condensation of phenols with formaldehyde, etc. Distillate previously dried and warmed to 50-60° is shaken with 5 per cent. of oleum (containing 27 per cent. of SO_3). The acid layer with the resinous substances is run off the following day and the oil remaining behind is aerated and extracted with 3 per cent. by weight of 48 per cent. acid.

The authors examined the aqueous-alcohol extract containing the sulphonic acids and the oil obtained after the extraction in relation to the number of successive treatments in this manner: Petroleum distillates, 0·883—0·898 sp. gr., $n\frac{15}{D}$ —1·49—1·50, viscosity Engler at 50° 1·47—1·95, with 28·5—0·5 per cent. going over below 300°, served as starting material. The acid number of the aqueous extract first rose and then dropped. In the first stages the increase of the acid number was accompanied by a decrease in the resinous substances in the acid layer. Obviously the oleum is first used to form resins and then to sulphonate. When the sulphonatable material is exhausted, the activity of the oleum ceases, excepting less definite reactions which are manifested by the evolution of sulphur dioxide. The properties of the residue are scarcely altered by further treatment. It is lower in density, viscosity, refractive index and specific refractions, and has a higher aniline point than the original oil. It consists chiefly perhaps of naphthenes. Since the sulphonation chiefly affects the aromatics, the yield of contact substance is higher (13—22 per cent. of the original oil), the higher the density of the original oil. This yield requires 38 to 45 per cent. of oleum. W. H. T.

560. Art of Distilling Hydrocarbon Material. E. M. Clark. U.S.P 1,625,984.

Pitch residue is distilled with the addition of steam until the still wax is carried over. The steam supply is then stopped and distillation is continued to the formation of coke. The residue is gradually fed into the still at the rate of 10 per cent. of the charge per hour, and the supply of steam continued until the still is fully charged. P. D.

561. Improvements in or Relating to Bituminous Paints and Like Coating and Impregnating Compositions. Colas Products, Ltd. E. P. 274,955. July 28, 1927.

Under certain conditions, when a bitumen-in-water emulsion is broken down, the product obtained takes the form of a jelly. A product of this nature can be obtained by mixing a bitumen-in-water with a reversed (water-in-bitumen) emulsion.

The patent describes a method of manufacturing a bituminous paint comprising a reversed bituminous emulsion or bituminous jelly in which a pigment is incorporated. The original emulsion can be prepared by the method described in Specification No. 202021.

The following are the constituents of a typical paint prepared by this method :—

Mexican asphalt	250	grammes
Venetian red in oil	200	„
Oleic acid	10	„
2 per cent. caustic soda solution	63	c.cs.
Water	250	grammes.

The pigment may be incorporated with the solvent employed in carrying out the reversal process. W. H. T.

See also Abstracts Nos. 526, 529, 530, 544 and 633.

Analysis and Testing.

562. The Drop Number and Emulsifiability. R. Christie Smith and (Miss) I. C. Dow. *J. Phys. Chem.*, 1927, **31**, 1263.

Further evidence against the assumption that the drop number of a mineral or vegetable oil is an index of its emulsifiability is adduced. Direct measurements of the drop number and emulsifiability (compare *Rev. gén. Colloïdes*, 1927, **5**, 412) for a number of oils show that there is no such connection. It is pointed out that the emulsifiability of an oil depends upon the ease of dispersion of the disperse phase and also upon the stability of the resulting emulsion. The first factor will be proportional to the lowering of surface tension, but the second will depend upon a variety of factors. The drop method is at fault as it only takes account of the first factor. R. P. L.

563. Molecular-weight Determinations of Difficultly-soluble Substances. Carlsohn. *Ber.*, 1927, **60**, 473; *Brennstoff-Chem.*, 1927, 236.

The Rash method (*Ber.*, 1922, **55**, 1051) gives too high values with substances not easily soluble and with those melting above 180°. Instead of determining the melting point, the author takes the solidifying point and, cryoscopically, the approximate solubility, the former being measured on the whole melt.

0·1 to 0·2 g. of camphor are heated to 180—190° in a sealed tube until the solution is clear, cooled slowly and the solidification which occurs within a degree observed. Solutions which are too concentrated require a greater temperature interval to solidify. Molten substance, undissolved, separates first and can be observed with a lens. Momentary solidification occurs at the eutectic point. The lowest temperature is read. The usual formula gives a too great molecular weight as all the substance is not in solution.

The quantity of the substance dissolved can be calculated from the estimated molecular weight and the lowering observed. A new test with this quantity should then give the same lowering of melting-point. If the molecular weight is lower than that estimated, undissolved substance separates first and then solidification is uniform. If higher, the depression is smaller. G. S.

564. A New Absolute Manometer for Low Pressures. W. R. Rodebush and C. C. Coons. *J. Amer. Chem. Soc.*, **49**, 8, 1953.

The mercury manometer, or McLeod gauge, cannot be used with gases which react or dissolve appreciably in mercury, nor with gases which condense at the temperature at which the manometer is maintained. Again, the temperature range of operation is limited by the physical properties of mercury. Daniel's glass diaphragm manometer is satisfactory at pressures above 10 mm., but in order to secure accuracy at low pressures the glass diaphragm must be made so thin that it is too fragile for practical use.

In certain laboratory work, a manometer is needed which can be used for the measurement of very low vapour pressures of substances at any temperature, and also for the measurement of thermal transpiration effects at low pressures. A suitable absolute manometer can be constructed of

Pyrex glass or silica and can be used at any temperature that the material will withstand.

It consists of a graphite disc, the lower surface of which is ground to seat on the ground end of the vacuum tube, the disc being suspended by a quartz fibre from a suitable arm. The whole is enclosed in glass, and a small bob of soft iron is attached to the fibre at the top near the point of suspension. A small coil is arranged round the outside of the apparatus, in position, a little lower than the iron bob, and a current can be passed through the coil in order to bring an electromagnetic traction on the bob. When the disc is seated on the tube at low pressures, the leakage is slight and a nearly perfect vacuum may be maintained in the vacuum tube, while pressure equilibrium is attained above. Sufficient current is passed through the coil to seat the disc firmly and time is allowed for pressure equilibrium to be established. The current is then decreased until the disc rises from its seat on the end of the tube, and at this point the apparatus functions as an electromagnetic balance. The upward pull of the suspension arm is equal to the weight of the system plus the pressure of gas, plus the electromagnetic force. The current at which the disc begins to rise from its seat is easily determined, for on equalising the pressure, a sudden rise of the disc is observed to a height of nearly 1 mm. above its seat. The disc has an area of 3cm.^{2} and a pressure of 0·01 mm. exerts a downward pull of about 40 m.g., so that it is easy to get sufficient sensitivity. It is convenient to check the apparatus against a McLeod gauge using air in the apparatus, and the "zero point" can always be checked against a vacuum. The manometer is, of course, unsuitable where the escape of gas from the apparatus must be avoided. W. H. T.

565. The Purification of Toluene for Thermo-Regulators. G. D. Beal and B. L. Souther. *J. Amer. Chem. Soc.*, **49**, 8, 1994.

It is essential that the toluene used in mercury-toluene thermo-regulators be free from certain impurities, notably sulphur compounds. These impurities foul the surface, and interfere with the sharp adjustment of the regulator. A suitable means of purifying the toluene is as follows: Boil under reflux condenser with sodium amalgam containing 1 per cent. sodium, then decant off the toluene, wash with water, and finally distil. The water remaining in the toluene will be removed in the first small fraction of distillate which can be rejected. W. H. T.

566. Apparatus for Vacuum Distillation. Garvin and Foster. *Oil and Gas J.*, Sept. 8, 1927.

The apparatus consists essentially of a modified Hempel flask attached to an evacuated receiver containing nine graduated test tubes on a horizontal rotating table.

In the neck of the distillation flask is fitted a spray screen consisting of two domed pieces of brass or copper gauze brazed to a copper tube of 4—5 mm. diameter. It is essential that the mesh of the gauze be not smaller than 10—14 mesh, so that a column of oil may be prevented from building up above it and spattering. When this antispray device is in position the neck of the flask is drawn out to a finer opening to minimise leaks.

Before each distillation pieces of porcelain are dropped into the flask, but this does not prevent bumping entirely unless the side arm of the flask is bored at the end to prevent droplets hanging on until they attain sufficient size to completely block the tube. Should this happen the increased vacuum caused when the droplet falls causes spurting.

The vacuum is supplied by "Cenco Hy-Vac" pump and the regulation of pressure is by hand valve. A. R. S.

567. All-Metal Laboratory Still Easily Made. *The Refiner*, Aug., 1927.

A very economical all-metal retort has been devised by petroleum physicists working in conjunction with the Bureau of Mines. The still is designed so that it may be converted almost instantly from a Hempel type retort into an Engler distillation unit. The still is made from a 10 in. section of 8 in. iron pipe, the ends being made by welding on a flat piece of iron of about the same weight as the pipe used for the cylindrical shell. A 2 in. opening is left in the centre of the top plate of the still. Into this opening a section of 2 in. iron pipe 14 in. long is welded, forming the dephlegmator or tower. The top of the tower is closed with an ordinary pipe cap in the centre of which is cut a $\frac{1}{2}$ in. hole for the insertion of the thermometer. The vapour outlet is welded on 2 in. from the top of the tower at an angle conforming to the specifications of the A.P.I. and Bureau of Mines. At the top shell of the still is also placed a $\frac{1}{4}$ in. nipple and valve, providing for the introduction of steam. For the purpose of charging the oil, another opening $\frac{1}{2}$ in. in size is provided in the top, into which a nipple is inserted and a good valve provided at the top of the nipple. A $\frac{1}{4}$ in. opening provided with nipple and valve is placed at one side of the bottom of the still for the purpose of draining the residuum from the still. The entire still is well insulated with asbestos. The condenser box dimensions are 24 in. in length, $6\frac{1}{2}$ in. in width and $6\frac{1}{2}$ in. in depth, and it is made of sheet tin. Its supports are made of four 26 in. lengths of angle iron. For a Hempel distillation the tower is packed with Jack chain. The still has a capacity of 3 litres.

S. W. C.

568. A Convenient Form of Apparatus for the Determination of Melting Temperature. Lynn. *J. Phys. Chem.*, Sept., 1927.

Instead of the usual capillary tube method, a modification of Washburn's apparatus is used. An unsilvered vacuum tube of small diameter is internally heated by a coil consisting of 36 gauge nichrome wire wound on a glass tube. The small test tube containing the thermometer or preferably thermocouple and sample is placed inside this and heating continued to melt the sample. The external resistance of the circuit is now altered to give the desired cooling rate and temperatures plotted against time during cooling. Supercooling is avoided by the introduction of a small crystal of the substance. The flat part of the curve, relative to the total period of freezing is an excellent criterion of the purity of the substance.

A. R. S.

569. Rubber Stopcock Lubricants for High Vacuum and other Uses. M. Shepherd and P. G. Ledig. *Ind. and Eng. Chem.*, Sept., 1927.

A stopcock grease intended for high-vacuum work or general gas investigation should smoothly lubricate the ground surfaces and at the same time possess sufficient solidity or body to prevent its quickly working out from between these surfaces. It should have a very low vapour pressure at ordinary temperatures, and be as free as possible from objectionable chemical or solvent action. Lubricants compounded from rubber with paraffin waxes, jellies and oils are in more general use than other types. The general tendency in preparing this type of lubricant is to use too low a percentage of rubber, too low a temperature and too short a time of processing. The authors prepared a number of experimental rubber lubricants in a thermostated electric oven, the mixtures being contained in a large porcelain casserole and continuously stirred by a motor-driven propeller. Considerable resistance is offered the revolving propeller, so it was geared to produce

sufficient mechanical advantage. The standardised preparation of suitable lubricants was developed from a study of the following variable factors: (1) kind of rubber, (2) kind of vaseline, (3) kind of paraffin, (4) percentage composition, (5) temperature of processing, (6) time of processing, (7) method of cooling, and (8) ageing.

(1) Four kinds of rubber were employed—pale crêpe, smoked sheet, pure para and sprayed latex, all being freshly milled. Pale crêpe and smoked sheet have so far given the best results. Smoked sheet produced a dark-coloured lubricant of greater body than the others, which required no ageing period and retained a satisfactory consistency for 8 to 12 months. The pale crêpe lubricants were of a light colour and possessed less body than the smoked sheet compound but more than the para. Lubricants containing a higher percentage were semi-fluid when freshly made and required 10 days to set to a solid grease, but retained their consistency for 12 to 18 months. Lubricants containing much para were dark-coloured and semi-fluid and required 12 months to set to a solid grease, which was then not smooth but rubbery and gummy. Sprayed latex oxidised too easily and the lubricants while of good consistency were very dark and had a burnt odour.

(2) No actual difference in consistency was observed when different samples of vaseline were used, except for one type. Some vaselines recently placed on the market are apparently more crystalline than the average product of previous years and these should be avoided, as they produce granular lubricants.

(3) Paraffin ranging from 30° to 50° C. melting point was used. Good results were obtained with 36° and 40° C. products. The 50° C. product tended to produce a "caky" lubricant.

(4) The percentage composition of the lubricant is determined by its intended use. High vacuum work requires a viscous lubricant containing a high percentage of rubber. General laboratory work, including manipulation of gases, calls for a lighter lubricant, whilst a third lubricant which finds applicability to some work including volumetric burette cocks, is a light grease permitting easy manipulation of the stopcock. The following compositions for the three general purposes have been developed, though it is hoped to improve the high vacuum formula:—

		High vacuum.	General.	Light.	
Rubber	..	Pale crepe	31	6	Smoked sheet or pale crepe	10 parts.
Vaseline	..	White	24	7	White or yellow	18 „
Paraffin	..	M.P. 36° C.	5	1	M.P. 30° C.	1 „

In each case stir continuously for 190 hours at 155° C. Remove to 2 oz. ointment cans, a small portion to each can, and chill on ice immediately. Allow to age for 10 days before use.

If the percentage of rubber exceeds the limit given for the high vacuum type, the lubricant tends to become a sticky semi-fluid. Increasing the percentage of paraffin produces a "caky" lubricant. For special lubricants the percentage of vaseline may be increased above that given for the light type. An effort to make a lubricant by dissolving the rubber in cymene gave some apparently beautiful products prepared in the remarkably short time of 2 hours. No procedure tried, however, was successful in thoroughly removing the solvent and these lubricants possessed notable vapour pressures.

(5) It was found necessary to heat the solutions to a high enough temperature to destroy the structure of the rubber yet not so high as to oxidise it. The allowable range proved to be narrow—150°—160° C. In most

cases 155° C. was selected. Lubricants were not processed in inert atmospheres, firstly because stirring being necessary the apparatus would be complicated, and secondly the dissolved oxygen in the rubber might be sufficient to produce oxidation.

(6) Samples taken during the various stages of processing were held 6 months to observe the changes due to ageing. It appears that the rubber does not satisfactorily break down at 155° C., even though actual solution has occurred, much before 170 hours have elapsed. A sample taken between thumb and finger, pressed together, and drawn out by separating thumb and finger to their full extent, should present a single unbroken thread of lubricant. The occurrence of an actual chemical reaction involving the rubber and its importance in determining the suitability of the product, was clearly shown by continuing the processing for 376 hours in the case of the high vacuum types, samples of the mix being taken at regular intervals after 72 hours. The 72-hour samples tested between thumb and forefinger produced fine floating threads. Subsequent samples taken at 24-hour intervals up to 170 hours showed the same characteristic in a uniformly decreasing amount. The 170-hour product was fairly satisfactory and the 190-hour sample was smooth and quite satisfactory in every respect, both when fresh and after ageing. Samples taken at 260—360 hours were apparently further improved, but 6 months ageing developed their unsuitability, the rubber gumming out to form a hard, greaseless, elastic mass. At 376 hours the mix had changed abruptly to a solid mass, which an equal weight of vaseline failed to redissolve at 155° C. Apparently therefore the chemical equilibrium reaches an optimum at temperatures from 155° to 160° C. and reaction times of 180—200 hours.

(7) A sample removed from the oven on a steel spatula was perfectly smooth, while 2—4 oz. samples poured from the same mix into an ointment can formed a relatively coarse granular or crystalline compound. This led to the adoption of pouring a thin layer into an ointment can and standing this on ice to produce quick cooling. A fine smooth grease resulted from this treatment.

(8) Some compositions set from a sticky semi-fluid to a smooth grease in 10 days. Others, suitable at first, caked out in periods ranging from 6 to 12 months. In general the smoked sheet lubricants possessed sufficient body when fresh from the oven, and retained a desirable consistency until used up—say, 12—24 months. In the lubricants containing much rubber, though not in the case of the lighter lubricants, pale crepe requires a definite ageing period. Para requires a long ageing period, and latex more nearly resembles para. S. W. C.

See also Abstracts Nos. 541, 545, 546, 548 and 555.

Refinery Plant.

570. Application of Process Steam in Petroleum Refining. Peterkin. *Chem. and Met. Eng.* Sept., 1927.

For every gallon of crude oil processed to finished products, more than a gallon of water has been converted into steam. The steam has been used for the following purposes: pumping oil and water; heating oil in storage and process (condensing in closed coils); simultaneous agitation and heating by direct injection into the oil; distillation of oil at temperatures below the boiling points by direct injection into the oil, the heat being supplied in some cases by the steam itself, and in others by oil, coal or gas fire; refrigera-

tion for wax removal; production of electric power; miscellaneous uses as scavenging apparatus of inflammable vapours.

Economy can be practised by the use of low pressure steam such as exhaust from pumps and also by the use of central electric generating stations with Diesel or gas generators.

In the heavier distillates such as lubricating oils, the use of steam is being superseded by vacuum distillation using very low pressures. A. R. S.

571. Corrosion in Petroleum Distillation Plant. II. M. Freund. *Chem. Zeit.*, 1927, **51**, 528.

The presence of chlorides in the emulsified water in the oil, and the production of carbon dioxide by partial oxidation of the unsaturated hydrocarbons in the oil, are both considered to be the cause of corrosion of iron valves and condensing columns of crude oil distillation plant. The oxidation is due to the trapping of air in the steam used, or to leakage of air into the apparatus. The uncondensed gases from the distillation of Boryslav crude were found to contain 2·5 per cent. of carbon dioxide, and the issuing water from the plant contained 4 kg. of iron per 100 m.³ of oil distilled. This iron was present partly as chloride and partly as ferrous hydrogen carbonate. It is recommended to add lime or dilute alkali solution, and also to use air-free water in the steam boilers. W. H. T.

572. A Critical Analysis of Equations for the Designing of Fractionating Columns. L. H. Shirk and R. E. Montonna. *Ind. and Eng. Chem.* Aug., 1927.

The system water-ethyl alcohol was chosen for several reasons, the chief being that results would be more comparable with those of other investigators, most of whom have worked with this system. A suitable still was designed and the column constants for different ethyl alcohol-water mixtures were determined with varying and carefully controlled rates of distillation and reflux ratios. Using these constants the theoretical number of plates required for the separation of the various mixtures was calculated by each of the chosen methods. A comparison of the methods is thus obtained on the same set of data both as regards ease of calculation and accuracy of prediction. The basic equations upon which the theory of fractional distillation of binary mixtures is built have been derived by three different lines of reasoning. Sorel derived his equations from material balances; Gay entirely on heat balances; Murphree on the gas absorption equations of Lewis and Whitman. These fundamental equations have been applied to the calculation and design of fractionating columns in the following ways: (1) the algebraic stepwise procedure; (2) the graphical stepwise method; (3) the use of graphical integration; (4) Peter's method, which consisted in combining the liquid-vapour equilibrium equation with the basic equations of distillation and mathematically integrating the combined equation so obtained. None of the methods representing the first class was applied to the data, because they are obviously too long and involved to warrant their use in engineering practice.

The apparatus used consisted of an iron pot still carrying a 9-plate cast aluminium column. The reflux condenser was provided with a take-off to the product condenser, and the refluxed liquor returned to the top plate of the column was measured by an orifice meter. The column and vapour lines were lagged with one inch magnesia and wound with chromel wire heating element. The feed tank was equipped with float gauge and level indicator for determining rate of feed flow and delivered into a constant

head tank. The heated feed was passed into the third plate from the bottom of the column. The waste liquor was removed through a siphon. A record of still temperature was kept by a recording thermometer, and readings were periodically taken of the temperatures in the constant head tank, the top plate of the column, the top of the vapour line and the waste liquor siphon. The plates were of the bubble-cap type with slotted caps, one cap on each plate. At the end of the run the distillate and waste liquors were analysed.

The column efficiency is the total number of theoretical plates calculated by McCabe and Thiele's method divided by the actual number of plates used, and expressed as per cent. This represents the over-all efficiency of the column which was calculated by five different methods. The results show that the graphical methods give results which more nearly approximate the actual conditions than do the mathematical methods. The graphical method of McCabe and Thiele has been found to be the best adapted to practical use, as it is much the simplest and most rapid. Rodebush's graphical method most closely approximated the actual conditions, but is far more complicated. The method of Murphree is extremely useful when two or three volatile components are distilled, but is needlessly complicated for binary mixtures. Lewis's method, though simpler than Sorel's, requires considerable time to apply and is not recommended over the graphical methods. Leslie's method is more accurate, but still requires considerable time to apply. The equations derived by Peters contain a number of errors which yield expressions incapable of solution when the required values are substituted. The corrected equations give values which check those obtained by the use of Leslie's method. The use of ethyl alcohol and water gives values for plate column efficiency which vary between 30 per cent. when rate of distillation is high and reflux low and 90 per cent when rate of distillation is low and reflux high. By plotting the results obtained for experiments, it was found that K varies inversely as some function of the rate of distillation and directly as the reflux ratio. S. W. C.

573. Ryan Refining Process Manufactures Marketable Products Without Customary Treating. C. A. Zimmerman. *Oil Age*, August, 1927.

The plant consists of two stills having a charging capacity of 5000 barrels, the first of which takes off the gasoline content of the crude and the second the kerosene, engine distillate and stove distillate fractions. The gasoline comes off in three streams, at 56°, 54° and 48° Bé respectively. From the second still the first stream carries off the stove distillate (36—38°), the second the kerosene (38—40°), and the third the engine distillate (42—44°). The fuel oil remaining is better than required to meet the Navy Bunker "C" specifications. The stills consist of 6 in. pipe arranged in coils in a combustion chamber and having an inlet at the bottom and an outlet at the top. The outlet is connected to an expansion chamber which in turn is connected to dephlegmator and condensers. All reflux from dephlegmators goes through coolers and is a finished product, no reflux being re-run. The charging stock is first tested and water added in amounts from 4 per cent. up, according to the sulphur content of the crude. It is claimed that the water, when generated into steam, forms a medium which separates the carbon and sulphur in the expansion chamber from the hydrocarbon vapours, and retains them in the unvaporised oil so that they are eventually pumped away in the fuel oil. It is further claimed that the water converts the sulphur from a corrosive to a non-corrosive character. The condensed vapours are run straight to storage ready for shipment to market, requiring no chemical treatment whatsoever. The fuel consumption on each still

is 1½ per cent. The process is completely covered by patents taken out by the inventor, Thomas J. Ryan. S. W. C.

574. Vapour Stage Water Bath Lessens Corrosive Action. *Refiner*, July, 1927, 73-4.

The refining plant of the Terminal Oil and Refining Company at Houston was constructed five years ago for operation on heavy crudes such as those from Panuco and Smackover, but it has successfully treated light oils—*e.g.*, North Texan, and now deals with 2500 barrels of Panhandle crude daily. Despite the high sulphur content of the heavy charging stocks, corrosion is no greater than is experienced when running with lighter, less sulphurous oils. The crude is first pumped through a shell type heat interchanger, then through a pipe still preheater, and enters the first of three shell stills, each 10 by 30 ft. In the first still, light gasoline is removed at about 375° F., the crude then entering the second still in which the remaining gasoline is removed. The topped oil next traverses a second pipe still, in which its temperature is raised through 100° F. Finally, it enters the last still, fired at 650° F., the distillate being collected without fractionation and employed as charging stock for a standard Jenkins cracking unit. The two gasoline stills are each equipped with two 6 by 15 ft. towers in series, metal scrap being used as the packing medium. In the second of each pair of columns, a spray of water flows downwards in counter current to the vapours, thus effectively scrubbing out the hydrogen sulphide. It is this treatment which apparently reduces corrosion of the columns, packing and condenser equipment. H. G. S.

575. Apparatus for Distilling Oil. J. W. Coast, Jnr. U.S.P. 1,639,327. Aug. 16, 1927.

The invention relates to apparatus for distilling oil and, more particularly, to scraping mechanism designed for use in stills or any other receptacle.

The apparatus comprises a horizontally arranged still containing a supporting member formed with blade receiving openings and shaped to conform substantially with the heating surface of the still mounted on an endless carrier running lengthwise of the still, and a plurality of scraping members passing through the top and bottom walls of the supporting member.

Means are provided for returning the supporting member in inverted position to the first mentioned end of the still. Scraper blades are mounted loosely in the openings of the supporting member so as to gravitate against the bottom of the still when in operative position, being withdrawn by gravity as the supporting member is returned inverted.

The relative sizes of the blades and the openings are such that material adhering to the blades is removed upon withdrawal into the supporting member. The blades are weighted to maintain them normally in contact with the bottom of the still when in scraping position.

Nozzles are provided for withdrawing oil from the body of the still and directing it against the supporting member to prevent material from accumulating thereon, and chains are provided suspended from the central portion of the frame in order to drag upon the bottom of the still in any places unreached by the scrapers. H. S. G.

576. Oil Refining Apparatus. H. A. W. Howcott. U.S.P. 1,641,852. Sept., 1927.

A plurality of horizontal stills are connected to a vertical still below the oil level. Compressed air is admitted into the horizontal stills, and churned by paddles and propellers into the heated oil. The foam and oil pass into

the vertical still, which is equipped with an agitating device driven by the shaft passing through the horizontal stills. Steam is also passed into the horizontal stills and vertical cracking chamber. It is claimed that the combined effect of fuel heat, compressed air, steam and agitation by paddles, discs and propellers tend to break up thoroughly the molecules of the crude oil for the production of lighter hydrocarbons. R. P.

577. Steam Jacketed Still. W. Knapp. U.S.P. 1,639,189. Aug. 16, 1927.

The invention relates to a steam jacketed still comprising a cylindrical shell provided with ends upon which is mounted a split jacket shell. This is provided with flanged upper edges that are riveted tightly against the outer surface of the cylindrical shell. The compartment between the inner and outer shells is sealed by split ring like or substantially U-shaped end closures bevelled at their upper ends in order to fit snugly on the outer shell. The closures and shell are welded together.

The cylindrical shell is provided with a cleaning device, a pair of domes in communication with a vapour line which passes through a cooler box, a manhole, a guage glass and a charge and discharge pipe. Inlet and outlet steam lines are connected to the end closures. H. S. G.

578. Art of Refining Oils. Leaver. U.S.P. 1,635,719. July 12, 1927.

The oil and sulphuric acid are intimately mixed in a tube containing a plurality of horizontally bored holes and baffles contained in a tube of larger diameter. From here the mixture flows to a settling tank to remove all sludge, and thus into a treating tank containing conical trays bored with small holes so that the passage of the mixture causes gravity separation of oil and acid. The process is repeated, using caustic soda and doctor solution if desired. A. R. S.

579. Distillation Apparatus. W. K. Lewis. U.S.P. 1,626,346.

In order to control the temperature in a fractionating column, hot liquid from the still is by-passed through a heating coil or chamber placed in the bottom of the tower. The amount of liquid by-passed is controlled by three valves, and by inserting a pressure release valve in the pipe carrying the liquid to the column, the still may be operated under any required back-pressure. P. D.

580. Apparatus for the Distillation of Oil. F. T. Manly. U.S.P. 1,640,202. Aug., 1927.

The apparatus consists of a horizontal cylindrical still insulated to prevent overheating of the vapour space. The vapours from the still pass into a dephlegmator, where the spirit is separated from the heavier distillate. This distillate returns to the inlet end of the still and re-enters with fresh oil. At the other end of the still a draw-off cock allows the residue to leave the still continuously. The unconverted constituents of the oil are thus continuously fed back to the still for retreatment. R. P.

581. Furnace. Ivon S. Pieters. U.S.P. 1,637,159. July 26, 1927.

The patent covers a furnace suitable for heating oil refining stills and the like, and provides means for preventing the direct impingement of flames upon the still bottom.

The still is built into a furnace of common brick, preferably lined with monolithic refractory material installed in a plastic condition. Along the sides of the floor of the furnace are two fireboxes or tunnels of the same

refractory material, having a number of openings in their tops and other openings in their sides directed towards the centre of the furnace. Suitable burners are placed in the ends of these tunnels, and the products of combustion are emitted from the openings in the sides and through such of the top openings as may be left uncovered by firebrick blocks for the purpose. The flames emerging from the sides of the two tunnels are directed towards each other, which fact tends to produce complete combustion of any fuel which has failed to burn in the tunnel. The still, being set in the top of the furnace, is heated uniformly and without direct impingement of the flames. The products of combustion are led down at the back of the furnace to an underground flue, whence a certain proportion may, if desired, be recirculated to the furnace chamber by suitable means. E. R. B. S.

582. Heat Exchanging Device for Air or Other Media. A. Sandberg. E.P. 255,418. July, 1927.

The apparatus is a preheater with a regenerative material consisting of rotating discs so arranged in relation to two or more groups of channels, that a part of the discs is always situated in each of the groups of channels. The hot fluids pass through one group of channels against the rotating discs and the cold fluids pass through the other group of channels. Thus the heat is transferred from the hot fluid to the cold fluid.

In order to allow for unequal expansion or contraction of the metals employed, the partitions interposed between the discs are flexible and carried by shafts so arranged that they can slide independently of each other. R. P.

583. Apparatus for Heating Oils. F. E. Wellman. U.S.P. 1,639,622. Aug., 1927.

One, two or more circular rings of pipes are arranged vertically in an annular heating chamber. Heating is effected by a rotating burner, and means are provided for preventing air entering the furnace except as properly directed to the burner. The still pipes are connected to tanks at their upper ends by tubes above and below the liquid level. The raw feed inlet and the vapour outlet both pass through the roof of the central tank, and draw-off pipes are connected to the bottom of the circular rings of pipes. The process is continuous. R. P.

See also Abstracts Nos. 501, 517, 520, 522, 524, 533, 549, 551, 586 and 591.

Engineering.

584. Chromium in the Oil and Automobile Industries. *Petr. Times*, 18, 451, 446.

The particular properties possessed by a chromium surface include great hardness, making it resistant to abrasive action, and high resistance to attack by almost every corrosive agent. Hence, the comparatively frail protection offered by a thin plating is far more effective than that of other metals usually employed as protecting media. A coating as thin as 0·0003 in. is stated to be sufficient to resist scratching.

Chromium is immune from attack by all "ordinary" acids except hydrochloric acid, and unlike iron, has little affinity for sulphur. It is becoming common practice to protect the inner surfaces of cracking stills and tubes by chromium plating, as otherwise the steel of the stills rapidly takes up sulphur. Again, the pistons of pumps used for handling hot oil in cracking

processes are very liable to corrode; this can be obviated by a coating of chromium. Carbon will not adhere to chromium, but any deposit of this kind is retained very loosely and can easily be blown from the surface. With a thickness of coating of 0·0002 in., a pound of nickel will suffice to cover 110 sq. ft., but a pound of chromium, by reason of its lower specific gravity, and the thinner coating possible, will cover 266 sq. ft. W. H. T.

585. Discussion of Isothermal and Adiabatic Compression. A. G. Hegman. *Ref. and Nat. Gas. Mfr.* July, 1927, 63.

A. W. Hubbell has perfected and patented a method of injecting fuel into a two-cycle natural gas engine after the cylinder has been scavenged with pure air and the exhaust port has been closed. This obviates the loss of unburned fuel into the exhaust system and raises the efficiency of the two-cycle engine above that of all but the most efficient multi-cylinder four-cycle engines. Careful tests have shown that such two-cycle engines will work at a rated load on 8650 B.T.U. per brake horse-power hour.

Part II.

The writer submits the proposition that isothermal volumetric efficiency more closely approaches the true volumetric efficiency than does the adiabatic; that this is particularly true over the range wherein the ratio P_1/P_2 is less than six; and that the use of cylinder capacities based on the isothermal volumetric efficiency in combination with Weymouth's empirical horse-power curve determines the true horse-power more accurately than does the use of either the isothermal or adiabatic horse-power equations.

In support of his propositions the writer solves problems by alternative methods and gives curves to illustrate his points. E. R. B. S.

586. Lightning Protection for Oil Industry. E. H. Wilcox. *Oil & Gas J.* Sept. 15, 1927.

The usual type of apparatus employed to minimise the effects of lightning consists of some type of well-earthed conductor, either in the form of a protective net of wires placed over the objects to be insulated, or high towers. Such protection is adequate as far as the main discharge is concerned, but it does not prevent the occurrence of secondary discharges within the area. If any portion of the surface within the area is connected to earth in such a way that the induced charge due to the cloud cannot escape to earth in the short space of time allowed by the discharge, a secondary discharge will take place from this surface to some well-earthed surface.

Obviously, neither earthing nor insulating tanks to be protected by the earthed lightning conductor can prevent the secondary discharge, since both badly-earthed and well-earthed bodies are involved.

The ideal solution of the protecting problem is to prevent the occurrence of the primary discharge. The Cage system, described in this paper, seeks to do this by dissipating the charge in the area back to the cloud. Complete safety can be obtained if the rate of dissipation is greater than that at which the area charges up.

Figures for the rate of dissipation have been obtained by work on the laboratory scale. The charge in the area is allowed to leak back to the cloud from a raised system of three strands of barbed wire which completely encircles the area. A graph is given showing the variation of the rate of dissipation per foot of this system against the field gradient in volts per centimetre. The gradient at which the ordinary lightning discharge is imminent is stated to be about 5000 volts per centimetre; the curves show that

at 4000 volts per centimetre a dissipation rate of about 400 micro-amperes per foot of system is obtained.

The rate at which the charge is brought to earth is stated to be not greater than 990×10^{-15} micro amps. per sq. cm. This figure rests on observations made by Dr. Simpson on the current brought down by the rain during the monsoon. Introducing a factor of safety of two, this gives a current of 80 micro-amps. per acre. Thus, a cloud one mile in diameter (about 500 acres) should be discharged by 100 ft. of protective system.

In practice the area is surrounded by a closed system of three wires, each bearing discharging points separated by not less than 6 in. All tanks and so forth within the system are connected to it, and the whole is completely earthed down to the permanent water level. P. D.

587. Oil Spray Research. *Gas, Oil and Power*, Aug. 4, 1927, p. 238.

The equipment at the Pennsylvania State College for the study of oil-spray research is described. A pressure chamber 28 in. × 20 in. × 20 in. is used, tested to 800 lb. pressure and fitted with two plate-glass windows, one of which is provided with a wiper. Penetration is studied by the impinging of the spray on a pendulum device. Injection, both by automatic and by cam-actuated nozzles can be studied. The pressure indicator consists of a series of diaphragms deflecting at different pressures; at the instant the pressure reaches a pre-determined valve electrical contact is made between a diaphragm and a stop, a spark record is made on a rotating drum. W. N. H.

588. Modern Gas Pumps. Major F. Johnston-Taylor. *Gas and Oil Power*, Sept. 1, 1927, 247.

The cycle of operations in the ordinary Humphrey gas pump is described, together with a later modification so that a pump of this type may be made to work on the two-stroke cycle. The modification concerns the shape of combustion chamber and position of valves so that the charge for one cycle is drawn into the combustion chamber before the previous burnt charge has been exhausted. The shape of the head is such that the fresh charge remains almost undisturbed and fairly pure. Figures for fuel consumption at four cycle pumps, based on the Chingford pumps give 0·933 lbs. per horse-power hour as an average, and 0·773 lbs. as a minimum.

The five pumps at Chingford were put down in 1913 and are 7 ft. in diameter. They lift 30 ft. and have a total capacity of 30 million gallons of water per day.

Some details are given of two new and slightly smaller pumps at Cobdogla, South Australia. E. R. B. S.

589. A Slide Rule for Solution of the Problems of Flow through Orifices. H. G. Schnetzler. *Ind. and Eng. Chem.*, **19**, 9.

In cases where it is desired to measure the flow through a pipe which is not fitted with a flow-metre the simplest method is to use an ordinary sharp-edged orifice flow-metre. The general formula for flow through an orifice is

$$Q = C \frac{\pi}{4} d^2 \sqrt{2gh}.$$

Where Q = flow in cu. ft. per sec. at downstream density,
d = diameter of orifice,
h = head of fluid,
C = orifice coefficient.

C varies with the conditions under which the orifice is being used. It depends on the ratio of areas of orifice and pipe, and on the positions at which the

pressures on either side of the orifice are read. The most satisfactory positions for taking the pressures are 1·75—2 orifice-diameters from the orifice on the up-stream side, and 4·5 diameters on the down-stream. If these positions are kept the value of C may be obtained from a curve which is given, provided the two diameters are known.

When put into workable units the formula becomes

$$Q = 1325Cd^2\sqrt{l/p}.$$

Q = flow in cubic feet per hour.
C = orifice coefficient.
l = pressure drop across orifice in inches of mercury.
p = density of liquid at downstream conditions in lbs. per cubic foot.
d = orifice diameter in inches.

This equation may be written

$$Q = K\sqrt{l/p},$$

which may be solved for Q when K, l and p are known.

The slide rule consists of two parts. In the top part K is obtained from the known value of the diameters. This gives actually a fixed logarithmic scale for K which is one of the fixed scales on the rule. The other fixed scale is the one on which the value of Q is read. The slider has scales for p and l, which are arranged so that p may be in pounds per cubic foot and Q in cubic feet per hour (for gases), gauge pressure with Q in lbs. per hour (for saturated steam), specific gravity with Q in cubic feet per hour or 50 gallon barrels per hour for liquids. This necessitates four scales on the p side of the slider, none of which overlap. The l side has two scales giving the pressure difference in inches of water or mercury.

The ranges of diameters covered by the rule are :—pipes from 1 inch to 12 inches, orifices from ¼ inch to 9 inches.

Copies of the rule size, 20in. by 7 in. may be obtained. P. D.

530. Tools of the Chemical Engineer. VI.—Centrifugal Machines. D. H. Killeffer. *Ind. and Eng. Chem.*, Feb., 1927, 287.

The principles governing centrifugal separators are briefly and clearly set out, and it is shown that their possibilities as regards force of separation are limited only by the mechanical strength of such structural materials as are available for their manufacture.

Commercial machines are divided into two broad classes, those used for separating two immiscible liquids or a liquid and a solid having slightly different specific gravities, and those used for the extraction of liquid from fibrous materials or crystals.

The main features of several machines suitable for different types of separation in the two main classes are described and their advantages and disadvantages noted. The description of a continuous hydro-extractor is included. This machine, which was designed for the continuous extraction of water from coal, contains scrapers which remove the solid matter from the centrifugal basket as it accumulates, so avoiding the necessity of stopping the machine for the removal of each charge of material after drying.

Mention is also made of a machine for the clarification of enamels which will leave the semi-colloidal pigment in suspension and yet remove any large particles of pigment or foreign matter.

Centrifugal machines are readily applicable to the washing of soluble crystals with a minimum of loss by re-solution. E. R. B. S.

591. Tower Absorption Coefficients. R. C. Cantelo, C. W. Simmons, E. M. Giles and F. A. Brill. *Ind. and Eng. Chem.*, **19**, 9.

Experiments have been made on the conditions affecting absorption of a gas in an inert carrier by a liquid. The equation for such a process may be taken as $\frac{dm}{dt} = -K2\,(km-n)$. Where m is the concentration in the carrier, k is the Henry coefficient, and n is the concentration in the liquid. K_2 is a constant depending on the size of the tower, and may also on the liquid temperature, on m and on f, the ration velocity of gas/velocity of vapour.

In order to try the effect of varying conditions on K_2 experiments were made on carbon dioxide and sulphur dioxide, air being the carrier and water the liquid in both cases.

Curves are given showing variation of K_2 with water rate for both gases, and of k with temperature for sulphur dioxide.

The gas velocity and composition are of slight effect on the value of K_2 for a given flow ratio. P. D.

592. Device for Indicating the Consumption of Petrol by Vehicles with Respect to Distance Travelled. C. A. K. Cornwall and G. M. Tripp. E.P. 275,093. August 4, 1927.

The patent covers a device for indicating the consumption of fuel per distance run and also the amount of fuel remaining in the supply tank. The apparatus consists of a measuring tank, containing a float by which valves are actuated after a predetermined quantity of petrol has been consumed, thus replenishing the supply in the tank, and an indicating mechanism driven during the time the tank is emptying by suitable gearing from the speedometer cable, road wheels, or equivalent. The indicating mechanism may be a cylinder suitably geared to the driving shaft and calibrated about its circumference in miles per gallon, the suitable reading being selected by a fixed pointer. The driving mechanism to the indicator contains a clutch by which it may be disconnected during the time the measuring tank is being refilled, which clutch may be actuated by electrical or mechanical means from the float. The indicator contains a brake which is applied during the time the clutch is held out of engagement and also a light spring tending to return it to zero reading. The brake is released as soon as the measuring tank is filled and the clutch tends to return to re-engagement under the action of a spring. The re-engagement of the clutch is, however, retarded by the action of a dashpot for a sufficient time to allow the indicator to return to zero. An obscuring device covers the indicator drum while the clutch is engaged but is opened simultaneously with the clutch, thus showing the rate at which the fuel has been used during the time the previous measuring tankfull was consumed.

For showing the quantity of fuel remaining in the supply tank a counter mechanism is employed, which may be set to the appropriate reading whenever the main tank is replenished and which is tripped by an extension of the clutch operating mechanism each time one measuring tank full of petrol is consumed, thus reducing the reading by an appropriate amount.

E. R. B. S.

593. Improvements in Filters. Shell Mex Ltd., and J. Lawson. E.P. 275.695. April 9, 1926.

An improved construction of combined filter and non-return valve arranged for removal as a unit from the filter casing, and especially applicable to filters employed in conjunction with kerbside petrol pumps.

The filter comprises a frame, gauze or other suitable filtering means mounted thereon, a non-return valve and a filter casing, characterised in that the filter is closed except at one end, the frame carrying the filter means being at this end provided with a flange adapted to make a butt joint against the filter casing.

A form of construction as applied to a kerbside petrol pump comprises a main body or casing with inlet and outlet at the bottom and top respectively. At one side of the casing is provided an opening through which the filtering medium can be introduced, and which is normally closed by a cover plate. The filtering medium is formed of a cylinder of gauze mounted on an open-work cage attached to a cone forming one end of the filter, while the other end of the cage is attached to an endplate or cover provided with an opening normally closed by a flap valve. This end is clamped against an internal flange on the casing by a bolt screwing into the casing. The use of such a butt joint allows tolerances in the dimensions of either the plate or the flange that the manufacture of the interchangeable and detachable filter units is greatly facilitated.

In operation, when the pump is actuated, petrol is drawn up by the pump on its suction stroke and passes through the filtering gauze, through the non-return valve and through the outlet in the casing. On the return stroke, or when the pump is not in operation, petrol is prevented from flowing back by the non-return valve.

Cleaning or replacing the filtering gauze or the non-return valve can be accomplished by removing the cover plate from the filter casing and the bolt securing the filter cage to the filter casing.

H. S. G.

594. Liquid Measuring Apparatus. Soc. Hordoll and B. Plantin. E.P. 259,581. Oct. 6th, 1926.

Automatic apparatus for the measurement of a liquid supplied under pressure such as petrol, and a reversing mechanism for use in such an apparatus, comprising a reversing lever adapted to oscillate between two extreme positions and subjected to resilient means in such manner as to maintain the lever in one or other of its extreme positions, further means being provided to force the lever to the end of its travel just before it reaches the middle position when moving in either direction. H. S. G.

595. Improvements in Filters. E. J. Sweetland. E.P. 275,779. July 23rd, 1926.

This claim has no relation to that of E.P. 190,752 relating to a small filter adapted for use in connection with the internal combustion engine of motor vehicles, but to large industrial filters in which a filter aid is employed in the filtration of heavy chemicals, sugar solutions, glucose, starch, petroleum oils and other materials in large quantities.

The filter elements in the form of leaves or discs are carried by a horizontal shaft mounted in one part of a two part casing, means being provided for moving the two parts of the casing relatively to one another axially of the shaft in order to open the casing and expose the filter elements to view. Preferably, the moving part of the casing is mounted on wheels, and is adapted removably to be secured in a fluid-tight manner to the other part, whilst the movable part may be substantially equal in length to that part of the shaft which carries the filter elements and be provided at its lower portion with a discharge hopper.

Preferably, also, the filter leaves are formed of a plurality of sectors each of which is removable from the shaft in a radial direction. The shaft may be formed with longitudinal passages corresponding in number with the

number of sectors in each filter leaf, each of the passages being provided with a test cock whereby it may be determined whether or not all of the sectors in any longtitudinal row are operating properly.

Furthermore, the horizontal shaft may be provided with a variable speed drive and the supply, the wash water and the drainage pipes may be connected by means of a valve or valves with a single pipe connected in a readily detachable manner with the filter casing. H. S. G.

596. Valves for Controlling Flue Passages. R. Thomas and Co., and E. A. Jones. E.P. 275,697. April 13th, 1926.

A valve overcoming the disadvantages of the mushroom and plate damper types used in furnaces of an improved liquid seal construction.

The valve consists of a plate of dished formation secured relatively to a hinge pin adapted to pivot about a horizontal axis as determined by means disposed externally to the walls of the valve chamber. The lower peripheral portion of the valve and the lower portion of each of the walls of the valve chamber depend within a frame-like member of substantially trough shape in cross section filled with water or other sealing liquid, below the surface of which dip the lower ends of each of the walls of the valve chamber and the lower portion of the peripheral flange of the valve, each side of the trough-like member being of greater length than the corresponding side of the valve chamber.

In reversible recuperative furnaces the flue passages may be controlled by employing such valves in pairs and coupling them so that they partake of a balanced motion in operation.

The valves may be employed with advantage on gas-fired or other furnaces and gas producers. H. S. G.

597. Sealing-piston for Reservoirs for the Storage of Gas, Steam or Easily Evaporating Liquids. M. & M. Klonne. E.P. 264,140. Aug. 18th, 1927.

The piston has fastened to its edge a ring of single plates movable in a radial direction which carry a packing ring. The packing ring is constrained to press against the side of the cylinder by pressure from the movable plates. A. R. S.

See also Abstracts Nos. 525, 532, 625, 626 and 627, and also those under the heading of "Refinery Plant."

Antidetonation.

598. Autoxidation and Deoxidising Actions XXIII.—Autoxidation of Hot Liquid Fuels. C. Mouren, C. Dufraisse and R. Chaun. *Chim. et Ind.*, July, 1927.

Deducing from previous work that autoxidation and consequent detonation begin in the liquid phase, the authors heated various fuels at 160° C. in an atmosphere of oxygen and measured the gaseous absorption for ten hours. Paraffin wax, redistilled at low pressure, oxidised rapidly at 160°. If 1 per cent. of previously oxidised wax was introduced oxidation proceeded more rapidly. The following in 1 per cent. concentrations acted as negative catalysts for the oxidation—α α dinaphthylamine, β β dinaphthylamine, monomethylaniline, tetramethyldiaminodiphenylmethane and malachite green. Less active negative catalysts were hydroquinone, gallic acid, pyrocatechol, pyrogallol, leuco base of malachite green, *p*-phenylenediamine, *p*-nitrosodimethylaniline, sulphur, resorcinol, α naphthol, iodine, sodium

iodide, lead tetraethyl, phenyl desulphide, triphenylamine, salicylic acid, tin tetraethyl, tin tetramethyl and methylene violet B.N.

The following acted as a negative catalyst for several hours, then as a positive catalyst—diphenylamine, trephinylamine, methylene blue, dulcine and arsenic. Thiourea was the only positive catalyst found throughout its action.

In ·1 per cent. concentrations the following acted as negative catalysts—α α dinaphthylamine, β β dinaphthylamine and sulphur; reversal of catalytic effect, negative to positive, was observed with monomethylaniline, malachite green and tetramethyldiaminodephinylmethane. In ·01 per cent. concentration α α dinaphthylamine acted as a positive catalyst for 10 hours, while β β dinaphthylamine showed a reversal of effect after 4 hours.

Tetrahydronaphthalene is more easily oxidised at 160° C. than paraffin wax, decahydronaphthalene less so, and naphthalene is scarcely affected. The following act as negative catalysts in the oxidation of tetrahydronaphthalene in 1 per cent. concentration—malachite green, tetramethyldiaminodephenylmethane and pyrogallol. Towards decahydronaphthalene the following act as negative catalysts—α α dinaphthylamine, β β dinaphthylamine, arsenic tri-iodide and malachite green.

A petrol from Pechelbronn was similarly examined for ease of oxidation. On distillation the various fractions all proved to be much more easily oxidisable than the original sample, indicating that some negative catalyst was destroyed by distillation. Potassium iodide showed the presence of peroxides in these fractions, particularly in the early ones. The following acted as negative catalysts in descending order of efficiency on the oxidation of various fractions in 1 per cent. concentration—α α dinaphthylamine, β β dinaphthylamine, hydroquinone, malachite green, phenyl disulphide, monomethylaniline, pyrogallol, sulphur, lead tetraethyl, α naphthol, iodine, aniline, methylene blue and nitrobenzene.

Bromine and nitric acid, butyl nitrite and amyl nitrite acted as positive catalysts for a short time, the catalytic action then ceased.

Various animal and vegetable oils were similarly examined. Peroxides were found as the results of oxidation of vegetable oils, but not of animal oils.

W. N. H.

See also Abstracts Nos. 503, 504 and 535.

Cracking.

599. Canadian Shale-Oil and Bitumen from Bituminous Sands as Sources of Gasoline by Pressure Cracking. Gilmore. *Canadian Mines Branch Advance Report on Investigations of Fuels and Fuel Testing during* 1926.

The shale-oil used had a gravity of 26·3° Bé and a boiling range of 150—683° F., and was obtained from New Brunswick shale by distillation in a Pritchard Process retort. It was first topped, yielding about 23 per cent. of blending naphtha, and the topped oil cracked in a Dubb's still. Two runs were made by the non-residuum process, one at 175 lb. and the other at 150 lb. pressure, and two runs were made by the residuum process at 150 lb. The yields per ton of shale were 18 imp. galls. gasoline, 2¼ imp. galls. gas oil, 61 lb. coke and 440 cub. ft. gas.

After triple acid treatment, doctor treatment and steam distillation, the gasoline was water-white, sweet to doctor, non-corrosive and stable to light. Its anti-knock quality, on engine test, was equal to straight-run Pennsylvania gasoline plus 5 per cent. added benzol.

The bitumen used was extracted from Alberta tar sands by Clark's hot water-sodium silicate method. On dehydration it lost, with the water, 12 per cent. by volume as tops of 23° Bé gravity and boiling between 300—714° F. The dehydrated and topped bitumen, sp. gr. 1·061, 80 per cent. by volume of water-free bitumen was distilled in a fire still to 67·3 per cent. by volume gas oil and 31·9 per cent. coke by weight. The gas oil cracked in a Cross still at about 875° F. and 700 lb. and yielded 32 per cent. gasoline and 16 per cent. fuel oil. The total yields on the water-free bitumen were 39 per cent. gasoline and 20 per cent. fuel oil.

The refined gasoline is described by Cross as having good anti-detonating properties. Gasoline from Alberta tar sands by the Dubb's process was reported earlier by Egloff and Morrell as being a superior motor fuel with an aromatic equivalent of 30 per cent. G. S.

600. The Cracking of Shale Oil. Gault and Stemart. *Chim. et Ind.*, 1927, **17**, 402–3.

Experiments have been carried out dealing with the cracking of crude oil obtained from Autun shales. From a consideration of the results of the investigation, the following conclusions have been drawn:—

(1) The maximum yield of gasoline fraction is obtained at about 600° F., accompanied by a good yield of olefinic hydrocarbons.

(2) At about 650° F. the yield of olefines reaches a maximum, but the yield of gasoline is still quite good.

(3) The optimum temperature for operation is in the neighbourhood of 625° F.

(4) Gas production increases with the temperature, without reaching a maximum, but the production-temperature curve is almost horizontal at 650°—700° F.

On cracking gas oil from Autun shale similar results required temperature approximately 50° F. higher. The absorption of the olefines in sulphuric acid was found to be difficult to effect, the gases being polymerised rather than absorbed. In order to absorb the propylene, the gases must be cooled before absorption in 95 per cent. sulphuric acid, but it was noticed that the yield of iso-propyl alcohol was always much lower than the propylene content of the gases. W. H. T.

601. Low Boiling Products obtained by Cracking Paraffin Wax H. Herbst. *Zeit. f. adgew. Chem.*, 1926, 194–6.

The thermal decomposition of hard wax of melting point 50°—52° C. in presence of activated charcoal was effected in a still immersed in an electrically heated metal bath. The still was charged with 4 kg. of wax, a basket containing 670 g. of activated charcoal being suspended, and capable of rotation, in the still and the wax subjected to distillation at atmospheric pressure during a period of 42 hours. The vapours were taken through a reflux condenser, which could be either air or water-cooled, and thence through a cooler to a receiving vessel. The temperature of the bath increased from 315° to 450° C. and that of the liquid from 300° to 400° C. during the course of distillation. The yields of products by weight were: distillate (sp. gr. 0·766/20° C.), 70·8 per cent.; residue, 15·1 per cent.; gases and loss, 14·1 per cent. The distillate, which when fresh was water-white, was subjected to Engler distillation with the following results: volume to 100° C., 14 per cent.; to 150°, 32 per cent.; to 200°, 48 per cent.; to 250°, 64 per cent.; to 300°, 80 per cent.; 94 per cent. off at 365°. The residue, to which was added that recovered from the catalyst by gasoline extraction, consisted half of undecomposed paraffin and half of a slightly yellow oil

with lubricating properties and sp. gr. 0·890. The gases contained 3·4 per cent. CO_2, 15·6 per cent. C_nH_{2n} hydrocarbons, 1·0 per cent. O_2, 6·0 per cent. CO, 25·4 per cent. H_2, 48·0 per cent. CH_4 and 0·6 per cent. N_2.

The absence of coking and of the formation of asphaltic substances is noteworthy. If the process is carried out continuously so that the products boiling above 300° C. are recycled, the yields of products are: light benzene to 150° C., 26·79 per cent.; heavy benzene, 150°—210° C., 16·32 per cent.; medium oil, 210° to 300° C., 25·82 per cent.; gas oil over 300° C., 3·10 per cent.; residue, spindle oil containing wax, 10·79 per cent.; waste gases and loss, 17·18 per cent.

To crack substances whose boiling points lie below 300° C., in presence of activated charcoal, pressures of 10 to 25 atm. have been found suitable.

H. G. S.

602. Polymerisation and Other Chemical Reactions in the Sulphuric Acid Refining of Cracked Distillates. J. C. Morrell. *Ind. Eng. Chem.*, 1927, **19**, 794-801—*cf. ibid. Chem. and Met. Eng.*, 1924, **30**, 785; Brooks and Humphrey, *J. Amer. Chem. Soc.*, 1918, **40**, 822; Norris and Joubert, *J. Amer. Chem. Soc.*, 1927, **49**, 873.

The opinion that the polymerisation losses due to sulphuric acid refining of cracked products are high is contested on experimental grounds. Comparisons were made between the yield of a definite cut of spirit from treated and untreated samples of cracked pressure distillates. It is pointed out that figures obtained in this way only represent true polymerisation losses when the reaction solution loss due to the pressure of acid sludge is the same for the pressure distillate and the corresponding spirit. Experimentally it was found that in the case of the samples used, with an acid treatment of 1·55 per cent. (10 lbs.-bbl.) or under, the sum of the reaction solution losses of the spirit and gas oil components was approximately equal to the reaction solution loss of the pressure distillate.

Cracked distillates from gas oils and fuel oils from Californian and mid-Continent fields showed polymerisation losses varying from 1 to 1·8 per cent. for 1·55 per cent. acid. Certain distillates (Cushing field) showed negative losses which are attributed principally to the polymerisation of very low boiling hydrocarbons normally lost in distillation.

An increase in the end points of spirit fractions after acid treatment was observed in agreement with the results of other workers. This increase was found to depend upon the concentration and amount of acid used.

Polymerisation supplies only a partial explanation, and it is suggested that the increase is largely due to the presence of dialkyl esters of sulphuric acid which decompose on distillation yielding high-boiling substances.

The mechanism of polymerisation and the effect of the acid refining on the chemical composition of the distillates are discussed. R. P. L.

603. An Improved Process for Converting High-boiling Hydrocarbons, which have been freed from the Substances Soluble in Liquid Sulphurous Acid, into Low-boiling Hydrocarbons by Means of Aluminium Chloride. Allgem. Gesells. für Chem. Ind. m.b.H. E.P. 273,999, 1927.

An improvement on E.P. 272,433, 1927, consisting in subjecting the so-called residue oils before the renewed treatment with aluminium chloride to a treatment with concentrated sulphuric acid instead of sulphurous acid.

R. P.

604. Apparatus for Cracking Hydrocarbons. J. E. Bell. U.S.P. 1,641,941, Sept., 1927.

The apparatus has been designed for the prevention of coke formation and overheating of plant of the pressure distillation type. It consists of a horizontal still divided into compartments by baffles which but extend above the liquid level only, leaving a common vapour space. Each compartment has a coil of heating tubes situated in a heating flue beneath, and these coils progressively increase in size as the temperature of the flue gases decreases. The oil flows in the same direction as the flue gases, so that the heating coils increase in heating area also as the process of cracking progresses. By this method of working the oil is gradually subjected to successively milder conditions of cracking. R. P.

605. Manufacturing Gas from Heavy Oils. C. Chilowsky. E.P. 271,899, May 19, 1926.

Improvements on E.P. 183,828 being a process for production of non-condensable gases from heavy oils by atomisation and gasification of the gas oil in a combustion chamber, the oil cloud being subsequently led over a catalyst, either metallic or non-metallic—*e.g.*, iron, nickel, platinum, alumina, etc., raised to a temperature between 700° and 1000° C. by the products of combustion issuing from the furnace. The obtained gaseous products may be used in an explosion motor or for a furnace or boiler.

After atomisation of the heavy oil by the incandescent products issuing from the combustion chamber, a certain quantity of air is added to the mixture to cause partial combustion, preferably on the catalyst, to assure maintenance of the high temperatures. Steam may also be added to the oil cloud producing water gas and preventing clogging of the catalyst. Likewise, heavy oils containing coal in colloidal suspension can be similarly treated.

The combustion chamber supplies all the heat for the cracking. The cloud attains where the oil is gasified, a temperature of about 700°–800° C. keeping the catalyst at that temperature. Air is admitted to the combustion chamber, and this burns with the oil vapour maintaining the temperature.

The process may be combined with that of M. Mailhe for the production of petroleum oils from vegetable and animal oils by incorporating with the oil or oil vapour before circulation 1 to 10 per cent. of a colloidal suspension or a solution of a metallic chloride such as that of zinc, magnesium or aluminium. The chloride converts the vegetable oil to petroleum or heavy oils and the metallic catalyst converts these heavy hydrocarbons into light ones.

For the catalyst iron or steel turnings or filings and nickel or copper agglomerates can be used, but it is preferable to use the catalyst in the form of sheets, rods, tubes or wires placed parallel to the gas current, so that difference of temperature between the two ends of the catalyst may be reduced by heat conductivity. Metal may further be used molten—*e.g.*, the cloud may be bubbled through a crucible containing cast iron.

As non-metallic catalysts most refractory substances—*i.e.*, alumina, silica, silico-alumina products, coal, coke, carborundum, etc.—may be used, but a higher temperature will be necessary than with a metallic catalyst. The amount of heat absorbed by the cracking amounts to 8–15 per cent. of the total calorific value of the fuel. H. S. G.

606. Process for Cracking Oils. C. P. Dubbs. U.S.P. 1,638,113, 1927.

The oil is distilled under pressure in a still which is fitted along the greater portion of its length with a baffle inclining slightly downwards towards a residuum outlet, the upper end of the baffle being turned sharply upwards.

The raw stock, preheated by passage down the dephlegmator, enters the bottom of the still, moves forward under the baffle and then rises round the upturned portion of the baffle. The vapours escape through the dephlegmator whilst the heavy residuum is perodically flushed out, thereby removing the carbon which is deposited on the baffle. H. G. S.

607. Process of Treating Hydrocarbons. C. P. Dubbs. U.S.P. 1,638,112, 1927.

Heavy oils are pumped under pressure through a cracking zone and thence to an enlarged vapour chamber. The residue is taken to storage and the vapours enter an aerial reflux condenser. The condensate there produced is not allowed to return to the vapour chamber, but is commingled with the stream of raw oil entering the system. H. G. S.

608. Apparatus for Cracking Hydrocarbons. G. Egloff and J. G. Alther. U.S.P. 1,638,116, 1927.

The apparatus consists of cracking coils, expansion chamber, residue cooler, reflux condenser, condenser and receiver. The raw stock is pumped in an upward direction over baffles in the condenser so that a whirling motion is imparted to the oil, the hot cracked vapours passing downwards through pipes arranged vertically in the condenser. The reflux condenser is built on similar lines except that the partially preheated stock flows in a downward direction in counter current to the cracked vapours flowing through vertical pipes. The raw and preheated oil, together with reflux, is now pumped through the cracking coils and thence to the expansion chamber. A certain proportion of the cracking stock is also taken through the residue cooler to be preheated before going to the coils. H. G. S.

609. Process of and Apparatus for Cracking Oil. G. Egloff. U.S.P. 1,638,115, 1927.

The process consists in heating the oil in tubes under pressure, discharging it into an expansion chamber whilst under pressure and heating the upper portion of the interior of the expansion chamber. The unvaporised oil is withdrawn and the vapours refluxed before entering a condenser, the reflux flowing back into the expansion chamber. H. G. S.

610. Process for Cracking Oil. G. Egloff. U.S.P. 1,638,093, 1927.

The oil is raised to cracking temperature under pressure and then passed into an enlarged expansion chamber. The vapours liberated are taken up by a pump and forced at a higher pressure into an elongated vapour drum, which is fitted with a dephlegmator. The reflux from the latter is recycled, whilst the vapours are pumped at a still higher pressure through a condenser into a receiver. The apparatus comprises a battery of cracking coils each connected to a separate expansion chamber, there being one vapour drum for each battery. H. G. S.

611. Improvements in the Manufacture and Production of Liquid and other Hydrocarbons and Derivatives thereof from Mineral Oil or other Bitumens and Solid or Liquid Products obtained therefrom. I. G. Farbenindustrie A.-G. (*a*) E.P. 249,501, 1926; (*b*) E.P. 247,401, 1926.

(*a*) An improvement on E.P. 247,583, designed to apply the same treatment to mineral oils and their derivatives to obtain valuable liquid hydrocarbons of lower boiling point and practically free of unsaturated compounds.

Removal of sulphur and other catalyst poisons is not necessary. Three examples are given. (1) Nearly solid residues of crude American naphtha consisting mostly of unsaturated compounds are continuously passed with a mixture of one part of nitrogen and three parts of hydrogen over a contact mass consisting of 70 parts by weight of ammonium molybdate and 30 parts of aluminium hydroxide, the temperature being 450° to 500° C. and the pressure 200 atm. The product, in addition to a little methane, is a nearly uncoloured, mobile, completely saturated oil, 90 per cent. of which consists of colourless benzene boiling below 150° C., the remainder being a yellowish liquid of higher boiling point. (2) Jura shale oil containing 4 per cent. of sulphur gave a product containing 80 per cent. of benzine. (3) Mexican asphalt was dissolved in cyclohexane and similarly treated, the solvent being unchanged but the asphalt converted in high yield into benzene.

(*b*) A modification of E.P. 247,583 and 249,501, 1926. H. G. S.

612. Method of Hydrocarbon Oil Conversion. L. C. Huff. U.S.P. 1,638,735, 1927.

The oil to be converted is raised to cracking temperature in coils and whilst still under pressure is passed into an expansion chamber. The vapours and residue are taken off separately and then commingled in a second similar expansion chamber at a reduced pressure. The vapours now liberated are refluxed by incoming crude stock, the reflux being recycled. H. G. S.

613. Process for Obtaining Light Hydrocarbons from Heavy Cyclic Hydrocarbons or Derivatives. A. J. Kling and J.-M. F. D. Florentin. E.P. 253,507, 1926.

Heavy cyclic hydrocarbons or other organic substances having cyclic nuclei are converted into light saturated hydrocarbons by treatment with hydrogen (pure or containing a small amount of gaseous hydrocarbons and carbon monoxide) at initial pressures of at least 50 kg. per sq. cm., temperatures between 350° and 460° C. and with non-hydrogenating catalysts. The catalysts, which may be chlorides or other halides of the alkaline earths or earth metals or chlorinating or other halogenating agents, act as substitution agents whereby the cracking temperature of the substances is reduced. The process is applicable to the treatment of naphthalene and anthracene and their derivatives, heavy tar oils, pitch, colophony, coke and the like. Thus naphthalene, to which is added 5 per cent. of a mixture of chloride of iron and aluminium, heated at 450° C. for 2½ hrs. under an initial hydrogen pressure of about 90 atm. gave 60 per cent. of a light oil distilling between 100° and 200° C. Under somewhat similar conditions, but using 5 per cent. by weight of aluminium chloride as catalyst, dry pitch gave 40 per cent. of a mobile liquid volatile below 200° C. H. G. S.

614. Process and Apparatus for Splitting Fluid Hydrocarbons. C. Longhi. E.P. 275,281, Aug., 1927.

The process consists of forming an electric arc within a body of hydrocarbon oil by means of revolving electrodes, causing the arc to elongate, quenching the arc and forming a second arc at approximately the same point as the first arc was formed.

The apparatus consists of a vertical still having electrodes projecting through the wall into the mass of oil and a disc with electrodes projecting radially revolves within the still. A high tension current, which may exceed 50,000 volts, causes an arc to form between the electrodes intermittently as the disc revolves. R. P.

615. Process for the Treatment of Cracking of Sludge Residues. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. E.P. 270,274, Aug., 1927.

For the purpose of separating the finely divided asphaltic or carbonaceous deposit usually met with in cracked residue fuel it is proposed to use dilute sulphuric acid or a substance which is capable of reacting with water to form an acid product. For example, a ton of cracked residue from Venezuelan fuel oil is mixed intimately with 3 kg. of sulphuric acid and 6 kg. of water, then stored in a closed vessel for 10 min. at 150° C. The oil is then removed. This oil contains about 1 per cent. of deposit only and about 150 kg. of granular coke is left in the heating vessel. This may be easily removed.

R. P.

616. Process and Apparatus for the Conversion of Heavy Hydrocarbon Oils into Lighter Oils. V. W. Northrup. E.P. 275,120, Aug., 1927.

The oil to be cracked is vaporised in a still and mixed with the necessary amount of hydrogen containing gas. The vapour-gas mixture is conducted into an ionising cylinder consisting of an upright tube containing a central electrode. Thence the vapours pass into a catalysing tube of nickel specially designed for the purpose.

The temperature of the catalytic tube is important and varies for different types of crude oil, for example, Pennsylvanian oil requires about (900° F.) 470° C., mid-continent crudes about 50° higher.

The intensity of the electric current applied in the ionising zone is also varied (2000 to 8000 volts) as some oils are more easily ionised than others. Means are provided for dephlegmating and condensing the products and returning the heavier fractions to the still. Natural gas is used in place of pure hydrogen (about $\frac{3}{4}$ to $\frac{7}{4}$ cub. ft. per gall. of gasoline). It is claimed that a much larger yield of gasoline can be produced by this method than by the usual heat and pressure methods in use and without the usual deposition of carbon.

R. P.

617. Improvements relating to the Treatment of Mineral Oils by Heat to obtain Lower Boiling Oils. W. J. Perelis. E.P. 271,601, 1926.

The process is designed to convert crude oils, distillates or residues into a motor spirit fraction and a residual oil free from detrimental sediment. The oil is taken under pressure and in turbulent flow through three cracking coils in series. In the first coil, it is heated to cracking temperature, *i.e.*, 450° to 470° C., the temperature being reduced somewhat in the second coil and the maximum temperature, *i.e.*, 482° C., attained in the third coil. The product, after being used to preheat the incoming oil, during which it is cooled to a temperature at least 200° F. greater than the mean boiling point of kerosene, is passed into a vaporiser under reduced pressure and mixed with steam. The heavy condensed residue is withdrawn and the vapours passed through a tower in counter-current to the stream of incoming raw stock.

H. G. S.

618. Improvements in Apparatus for Hydrogenation of Liquids. G. R. Schueler. E.P. 274,952, July, 1927.

In hydrogenation apparatus, wherein the liquid is allowed to percolate through a catalyst in the form of nickel turnings, shavings, rolls of netting

or small pieces of nickel packed round a rod which passes centrally through a cage or cages, it is almost impossible to ensure that the greater part of the surface of the catalyst becomes effectively covered with the liquid. This type of catalyst has also the disadvantage that, during anodic oxidation, the action is not uniform but commences on the surfaces nearest the cathode and slowly proceeds to the centre of the cages.

The present invention overcomes these disadvantages by means of corrugated circular plates, perforated plates or helixes of nickel, each having a central hole to fit the supporting pillar on which the catalytic unit is built. This central pillar is preferably a perforated tube through which hydrogen may be introduced into the liquid undergoing treatment.

Oxidation of the catalytic plates or discs is readily effected by suspending them between cathode plates in an electrolytic bath. A form of apparatus for the purpose is described. R. P.

619. Improved Process and Apparatus for the Cracking of Oils. S. Seelig. E.P. 268,323, Aug., 1927.

In a process where oil is cracked by passing through a molten metal it is difficult to produce exact temperatures continuously. It is claimed that this disadvantage is overcome by interposing a heat absorbing medium between the heated wall of the cracking vessel and the interior space. This medium takes the form of a helical coil of metal tubing introduced concentrically. When the plant is in operation the heat from the wall of the reaction vessel strikes against the helical tube, the vapours contained therein expand and absorb the heat, and by reason of the low thermal conductivity of the vapours the coil forms a buffer layer which only slowly takes up the temperature of the wall of the cracking chamber. It thereby compensates for variations of temperature. R. P.

620. Process for Treating Heavy Hydrocarbons. A. D. Smith and J. Perl. U.S.P. 1,640,223, Aug., 1927.

The primary object of this cracking process is the prevention of the formation of carbon. The apparatus consists of two vertical heating coils and an upright still of special construction. The oil is cracked in the first coil, passes into the still where the light products are separated and the polymerised hydrocarbons precipitated. The recycle oil is passed through the second heating coil for further production of cracked products and returns to the still for separation of the products.

It is claimed that by this method of operation the polymerised products of cracking are eliminated from the system before decomposition proceeds to such an extent that coke is produced. R. P.

621. Improvements relating to the Treatment of Gases produced in Cracking Hydrocarbons. Société Anonyme d'Explosifs et Produits Chimiques. E.P. 251,652, Aug., 1927.

The process consists of successive operations of compression and cooling to separate the pentanes, amylenes and butylenes from the cracked gases.

From the residue propylene is removed by bubbling the gas through sulphuric acid or both propylene and ethylene may be removed by hypochlorous acid.

The remaining gases are treated with chlorine to obtain monochlor derivatives.

All the products are chlorinated, then converted into alcohols. R. P.

622. An Improved Process and Apparatus for Cracking Hydrocarbons. Standard Development Company. E.P. 274,763, 1927.

The invention is designed to crack residuum oils under pressure. The oil is raised to cracking temperature (about 455° C.) in a coil and is passed into one or more thermally insulated, enlarged drums, the pressure in coil and drums being from 300 to 350 lb. per sq. in. The cracked product is next delivered at substantially atmospheric pressure into a chamber provided with a fractionating column and residue draw-off. The chamber is heated internally by means of flues and externally if desired, sufficient heat being supplied to vaporise at least 30 per cent. of gas oil, in addition to the cracked spirit and kerosene. The vapours, after being employed to preheat the incoming oil, are condensed fractionally, the gas oil cut being collected separately. The sensible heat of the residual tar is also used for preheating purposes, whilst the degree of cracking is controlled to produce not more than 0·25 per cent. of sediment in the tar. H. G. S.

623. Process of Distilling Oil in Presence of Comminuted Carbonaceous Fuel. W. E. Trent. U.S.P. 1,641,305, Sept 6th, 1927. Compare U.S.P. Appl., Serial Nos. 361,230, 363,797.

The invention takes advantage of the fact that oils mixed with coal can be vaporised at lower temperatures than are required to distil the oil itself. It is claimed that cracking of oils in such mixtures can be accomplished at comparatively low temperatures to yield an increased percentage of gasoline and light oil fractions.

In carrying out the process comminuted coal and hydrocarbon oil mixed in a plastic mass are passed down a cylindrical tube through a distilling zone. Stirring and forward movement are effected by spiral paddles on a central hollow rotating shaft. Hot gases are passed down this shaft and through cavities in the interior of the paddles. The evolved gas and solid residue are collected separately at the same end of the heating zone. The temperature is such as to cause substantial cracking while preventing fusion of the residue, which is obtained as a dry powder. A plant for the condensation of the volatile constituents is described. R. P. L.

See also Abstracts Nos. 523, 529, 534, 575, 576 and 635.

Oil Field Technology.

624. Production Losses into Low Pressure Oil and Gas Sands. Bush and Wilhelm, Calif. State Min. Bur. *Petr. Times*, July 16, 1927, 119.

Oil wells are drilled through sands, the pressures in which vary from high to nil. Since ordinary production methods leave 80 per cent. of the oil in a fully saturated sand, oil from high-pressure zones are forced into low-pressure sands up to 80 per cent. of their capacity and lost there. Productivity is not proportional to depth, and would only be so if in sands of the same porosity the gas pressure increased with depth in proportion to increased hydrostatic pressure and resistance to upward flow.

Information has been collected by two companies in the Coalinga field as to the productivity and fluid level of four sands, and this was obtained by bailing and pumping as each sand was entered. Underground losses may be reduced by re-drilling an old well and perforating in the bottom sand first. If not productive, this part of the casing is plugged and the next section above perforated and tested.

By mutual agreement between operators it should be possible to study cores and only perforate in sections alike in pressure. In a very productive field the well could be drilled to the bottom of the oil zone and sufficient casing perforated to produce a gusher. As this gave out, the upper perforations could be plugged and the next section opened. When the gusher stage was finished the perforations could be cleaned out and pumping started. G. S.

625. Automatic Pressure and Volume Control of Gas to Oil Wells Producing by Gas Lift. J. V. Thomas. *The Oil Age*, Aug., 1927, 37.

A description is given of an improvement in automatic gas control valve systems which is known as the Thomas Gas Lift Control. The Thomas system allows a greater volume of gas to be delivered at suitable pressure whenever the back pressure of a well rises and *vice versa*. It comprises an automatic main control valve operated by the differential pressure across an adjustable orifice, the action of which is modified by the introduction of a second automatic valve into the pipes leading to the main regulating valve, this secondary valve being controlled by the back pressure of the well alone. By the adjustment of several handvalves in the pipes to the valve control chambers any predetermined variation in volume of air supplied with change of back pressure may be obtained. E. R. B. S.

626. Improvements in Deep Boring Apparatus. Edmond Lachamp and Edouard Perret. E.P. 275,379, June 18, 1926.

A combined rotary boring tool and a hydraulic turbine or motor are suspended within a column of tubing in such a manner that when lowered the housing of the turbine rests upon and interlocks with a seat in the tubing secured against rotation. The discharge water from the turbine returns to the surface outside the tubing column and the boring device and the turbine can be brought to the surface at any time without disturbing the tubing.

By means of a regulator between the motor and the tools, the pressure of the tools on the bottom of the borehole is automatically varied in accordance with the resistance met by the boring tool. When the boring tool is stopped the passage for the fluid is blocked and the excess pressure transmitted to the surface and used to indicate that the turbine has stopped. G. S.

627. Apparatus for Raising Liquids from Deep Wells and the Like. W. H. N. Loveday. E.P. 257,241, Aug. 4, 1927.

The patent covers an invention for raising water to any reasonable height without the use of lift and force pumps. The apparatus consists of two series of chambers alternately disposed at successively higher levels, the bottom of each chamber being connected by a pipe with a non-return valve to the top of the chamber immediately above which will be one of the other series. The tops of all chambers of one series are connected by an air pipe, as also are those of the other series, and by alternatively applying a relatively high pressure to one series and low pressure to the other water is forced from alternate chambers to the ones immediately above. The pressure changes may be controlled by a float-operated valve in, or connected with, any one of the chambers above water level, other than the last chamber. The vertical height between chambers is fixed by the difference in pressure which it is desired to employ.

By suitable arrangement the apparatus may be worked by the difference between atmospheric pressure and the partial vacuum produced by a vacuum pump, or, alternatively, by the difference in pressure between air delivered by a compressor and atmospheric pressure, or by a combination of the two.

For deep well work the whole underground system may be arranged inside a cylindrical casing forming the walls of the chambers. E. R. B. S.

See also Abstracts Nos. 498, 519 and 521.

Petroleum Geology.

628. Geological Distillation of Petroleum. J. L. Rich. *Gas and Oil J.*, Sept. 8, 1927.

The theory advanced is that in regions of intense mountain folding, carbonaceous rocks have become devolatilised, coals becoming changed from bituminous to anthracitic and oil shales losing their oils.

The primary stage in the history of great mountain chains seems to be the accumulation of a thick series of dominantly shallow water rocks in a deep geosyncline, about which the mountain building is later localised. These sediments are usually carbonaceous and often highly bituminous. The mountain building then occurs by the overthrusting or overriding of great slices of the earth's crust, crumpling incidentally the weaker carbonaceous strata and forcing them into a zone of relatively high temperature and pressure.

Thus the rocks are placed under favourable conditions for distillation similar to those existing in a high-pressure still, where anything up to complete devolatilisation of the rocks may take place.

The excessive pressure then tends to drive the evolved gases upward towards the surface or laterally along the bedding of the sediments. The excessive pressure and low viscosity of the oils at the high temperature existing would make migration exceedingly probable in a lateral direction, although upwards would require the supposition of faults in the overlying strata.

Following these stages the mountains suffer a broad regional upwarping which makes for the establishment of an artesian circulation and makes for a widespread readjustment of the rock fluids with a tendency towards movement away from the mountain region. Such movements might be complex and might be carried on continuously or intermittently during succeeding geologic ages and under varying physiographic evolution stages. In this way the final resting place of the oil might be far away from its source of formation.

The generation of large quantities of petroleum in the manner outlined seems almost a necessary result of geological conditions which are now known to have been commonly associated with mountain building. Study of the world's oilfields with this hypothesis in mind would show many of them to be related somewhat in the manner outlined to belts of dynamic metamorphism competent to have been the sources of the oil. A. R. S.

629. Decomposition of Vegetable Matter under Soils Containing Calcium and Sodium as Replaceable Bases. E. McK. Taylor. *Fuel.* 1927, **6**, 359-367. Compare *ibid*, 1926, **3**, 195-202.

The decomposition of various types of vegetable matter in soil under roofs containing calcium and sodium-alumino-silicic complexes has been studied. It has been shown that the calcium complex does not form an impervious roof, and hence that decomposition is not anærobic. In addition, hydrolysis of the calcium complex is slow and the conditions are therefore favourable for the formation of acidic oxidation products. Under a roof containing sodium-alumino-silicic complex, however, alkaline anærobic conditions are produced. Bacterial decomposition of sugar and starch under these conditions leads entirely to the formation of gaseous products. Cellulose decom-

poses similarly but more slowly without the formation of "humic" residue. Some ferrous sulphide is produced from iron and sulphur compounds in contact with the cellulose. The starch, sugar and cellulose of green leaves are decomposed in the same way as the pure materials, but the plant cuticle remains unattacked under these conditions. Experiments on the decomposition of wood in this manner showed that the alkali-soluble humus did not yield a solid residue. Mature beech leaves showed the development of a solid black material closely resembling fusain. After three months this contained 47·3 per cent C. against the 33·8 per cent. C. of a similar sample kept under a calcium-complex roof. Peat was found to decompose under alkaline anærobic conditions, but the products were not examined. From the results it is deduced that the lignin and not the cellulose portions of the plant are responsible for the production of fusain.

The relation of these experiments with the discovery of fusain in peat under an alkaline roof in Egypt and with the formation of bituminous coal is discussed. R. P. L.

630. Peculiarities of the Pecos Oil Field. Dameron. *Oil and Gas J.* Sept. 1, 1927.

The output of the field at the present time is unduly small, due to the fact that the storage and transport facilities are extremely inadequate. Drilling also presents difficulties, usually in the first 200–300 feet, due to the fact that there is a gravel bed averaging 300 ft. in thickness, through which the drilling speed is small. Also the mountainous nature of the country necessitates drilling in narrow valleys and cliffs where heavy plant and material can only be brought by means of winches. In some districts caterpillar tractors are much in use.

The crude oil obtained is paraffinoid and contains approximately 1·5 per cent. of sulphur. The sulphurous gas evolved in drilling is present in sufficient quantity to make the wearing of gas masks necessary, and in most cases the gas is burned on release. A. R. S.

See also Abstract No. 518.

Coal and Shale.

631. Investigations of Eislingen Shale Oil with Particular Reference to its Low-boiling Constituents. K. Neubronner. *Petroleum*, 1927, **23**, 789–796.

The oil is obtained from deposits in the Staufen shale basin in Wurtemberg, the industry being favoured by the local demand for the residue as a building material, though rendered more difficult by the considerable depth of overburden. The deposits consist of two beds found in the Lias E formation, the thickness being 3·5 to 4·5 m., and the percentage of oil by weight recoverable varies from 3·5 to 6·5 per cent., being greatest in the upper half of the under seam. The shale was carbonised in a rotary cylindrical retort 5 m. long and 2 m. in diameter, 6 per cent. to 6·4 per cent. oil being obtained, and 2·9 per cent. or 35 litres per kilo. of gas with a net cal. value of 4950. The net cal. value of the shale was 1380 cals. per kilo. The crude oil had sp. gr. 0·900–0·920, open flash pt. 20° C., wax content 0·45–0·50 per cent. and sulphur content 2·30–3·50 per cent. The distillation test gave 30–34 per cent. over at 200° C. and 63–71 per cent. at 300° C. The crude oil was a mobile dark brown liquid; 25 litres were distilled in an atmosphere of nitrogen, and the fraction up to 150° C. was repeatedly redistilled till separated into fractions of 1°–2° C. range. At the beginning of the redistillation gases escaped consisting mainly of hydrogen sulphide with a small proportion

of ethylene hydrocarbons. 10·6 per cent. on the crude oil distilled over up to 125° C. and 6·40 per cent. from 125° to 150°. The fractions up to 74° C. remained colourless, while those up to 125° C., colourless at first, turned dark in colour and gave a red-violet deposit on standing. The mercury acetate and picric acid values, and refractive indices of fractions 70° to 102° C. were determined. The distillation curve shows decided turning points at 75–76, 80–81, 94–95, 110–111, 122–123 and 142–143° C., the maxima of gravity and refractive index lying in the boiling ranges of benzene, toluene and xylene, but these points corresponding to the minima of quantity of distillate. The maxima of distillate lie near the b. ps. of hexane, heptane and octane, and the corresponding unsaturated hydrocarbons. From the mercury acetate value a high degree of unsaturation was indicated in the fractions, and the picric acid values correspond with the maxima aromatic values. In refining the 150° fraction the diolefines were amenable to sulphuric acid and soda treatment, but the removal of sulphur compounds presented great difficulty. The benzene fraction up to 180° C. had a gravity of 0·790–0·795, a sulphur content of 3·5 to 4·0 per cent., and a very unpleasant smell of sulphur compounds. It polymerised readily with deposition of asphaltic substances and coloration of the fraction. Refining with about 5 per cent. of sulphuric acid of average 66° B. and 1–1½ per cent. of 15 per cent. soda solution gave a spirit with passable smell. The use of sodium plumbite solution did not give any better results than obtained with soda alone. The loss in distillation and refining amounted to 8–9 per cent. The refined benzene has sp. gr. 0·780–0·790, $n_{\frac{D}{20}}$ 1·4500–1·4540, mercury acetate value 300–340 and sulphur content 2·55–2·65 per cent. By passing the vapours over freshly ignited bauxite the sulphur content was reduced to 1·65 per cent., but a commercially feasible way of de-sulphurising the benzene was not found. H. M.

632. Low-Temperature Distillation. Runge. *Mech. Eng.*, Aug., 1927, 875.

Rotary kilns are unsatisfactory for distillation, as the shale has to carry its own weight in addition to that of the coal. At 1200° F. mild steel has only 25 per cent. of its tensile strength at 70° F. The use of rotary retorts is also limited to non-coking coals.

In externally heated concentric-drum retorts the temperature of the inner drum, which carries the weight, does not exceed 500° F., at which temperature the steel is near its greatest strength. The coal is only preheated in the inner drum and passes to the outer drum for carbonisation. The vertical stationary retorts used in England are similar to high-temperature by-product coke plants, being heated externally and run intermittently.

In a third type of retort the coal is moved by paddles. The coke produced is light and fluffy and requires briquetting or pulverising, this adding to the cost. A process yielding a hard, lumpy coke has better chances of success.

The calorific value of a coke from a low-oxygen coal is from 700 to 1000 B.Th.U. lower than the original coal, while from a high-oxygen coal it is approximately the same. The coke from lignite may be 2000 B.Th.U. higher than the original fuel. Low-temperature gas is rich and suitable for mixing with producer or blue water gas. The average yield of tar per ton from sixty coals of at least 30 per cent. volatile matter was 27 to 32 gallons, the tar producing on an average 60 per cent. oil and 40 per cent. high-melting pitch. The pitch, melting at 300° F., can be pulverised and used as fuel.

For a plant with a throughput of 500 tons of coal per day, a conservative estimate shows $3·82 per ton profit. A more conservative basis gives $1·82 profit per ton. G. S.

633. Improvement in Emulsifying Agents and the Production thereof. J. H. Disney and J. C. Kernot. E.P. 274,142. July 15, 1927.

Many attempts have been made to emulsify coal tar pitch and similar substances, and in some instances resins or other saponifiable material in combination with commercial glues or gelatines have been tried as emulsifying agents. This patent therefore describes a process for producing an emulsifying agent for use with coal tar pitch or other similar material. The method consists of incorporating with resin or other saponifiable material, a glue or gelatine prepared from raw material treated in the following way :—Washed, and then subjected to a series of treatments with dilute alkaline solutions, followed by further washing and finally a series of treatments with dilute acid solutions. The specially prepared glue or gelatine is mixed with a resin obtained by the sulphite process of manufacturing wood pulp, and the resulting product allowed to set to a jelly. Generally, a concentration of one part of the specially prepared glue or gelatine and one part of water is mixed with two parts of liquid resin, at a temperature of from 40°–50° C. W. H. T.

634. Improvements in the Production of Liquid Hydrocarbons and Derivatives thereof from Coal, Tar and the Like. I. G. Farbenindustrie A.G. E.P. 249,155, 1926.

The present invention is an improvement or modification of the process described in E.P. 247,217, designed to convert coal, tar, mineral oils and the like into benzenes, lubricating oils, etc., by treatment with gases containing hydrogen and carbon oxides under pressure and at an elevated temperature in presence or absence of catalysts. The gases must be prevented from coming into contact with free iron, nickel or cobalt in the hot parts of the vessel. The inner surfaces of the latter are therefore made of copper, silver, aluminium or alloys thereof, of chromium, manganese, vanadium or uranium, or of special steels with a considerable percentage of manganese, titanium, chromium, tungsten, vanadium or molybdenum. Metal carbonyl vapours must be removed from the reducing gases—*e.g.*, by means of active adsorbents like charcoal or silica gel. H. G. S.

635. Improvements in the Manufacture and Production of Hydrocarbons. I. G. Farbenindustrie A.G. E.P. (*a*) 249,156, 1926; E.P. (*b*) 274,404, 1926.

(*a*) The conversion of coal and the like into hydrocarbons is effected by the action of hydrogen at elevated temperatures and at pressures exceeding 50 atm., the tar-like material produced in the first stage being subjected to a second similar treatment. The hydrogen is preferably introduced in the form of a stream. The catalysts employed may be those specified in E.P.'s 247,582–3–4, or difficultly reducible metal oxides such as have been suggested for the catalytic manufacture of methanol—*e.g.*, zinc oxide.

In the example quoted, air-dry lignite, alone or mixed with oil, is continuously pumped into a high-pressure reaction vessel and is moved forward slowly in counter-current to a stream of hydrogen in excess of theoretical requirements under a pressure of 200 atm., the temperature being 450° C. The hot gas stream containing the products is conveyed into another pressure vessel containing a catalyst consisting of calcium carbonate and heated to 500° or 550° C. The gases are then cooled after heat exchange and thin hydrocarbons containing about 50 per cent. of benzene are separated. The gaseous hydrocarbons are removed from the spent gas, fresh hydrogen added and the resulting gases re-circulated. The solid residue left in the first vessel is continuously removed.

(*b*) An improvement on the above consisting in introducing the tar vapours obtained in the first stage into the second stage without intermediarily condensing them, and preferably after separating them from the ashes or other solid residues. H. G. S.

636. Improvements in or Relating to the Distillation or Heat Treatment of Carbonaceous or like Materials. Salermo, Ltd., and M. Salermi. E.P. 273,528, 1926.

The process is a continuous method of distilling carbonaceous materials in which the coal, etc., in a crushed form is made to move in thin layers through drying and carbonisation chambers in counter-current to and in contact with the waste gases used for distillation purposes, the carbonisation chamber being externally heated. The preliminary drying operation is effected by carrying the coal in thin layers over flat metal plates, the pre-treated material then falling through a gas-tight seal into the first of a series of open-topped troughs arranged side by side. The troughs are fitted with rotating blades which continuously stir the charge and cause it to flow from one trough to the next. Finally, the coke passes through a second gas-tight seal into a cooling chamber or it may be taken whilst red hot to the furnace of a steam generator or other heating apparatus. The distillation products are passed through a dust extractor before condensation takes place. An installation consisting of a single retort with 12 troughs, each 10 ft. long and 8 ins. in radius can deal with 75 tons of coal per 24 hours, drying and carbonisation each occupying from one to two hours. H. G. S.

637. Improvements in the Recovery of Benzenes from Coal Gas. N. V. Silica en Ovenbouw Mij. Assignees of Dr. C. Otto & Comp. G.M.B.H. E.P. 265,984. July 28, 1927.

A process for the recovery of benzene from wash-oil in continuously operating plants for the recovery of benzene from coal gas is claimed whereby the efficiency of the recovery is greatly increased. Benzene is recovered from the wash-oil by vacuum distillation and it is found that a part of the benzene vapour is lost with the exhaust gas of the vacuum pump. Three methods of reclaiming this part of the benzene are given :—

1. Part of the wash-oil may be withdrawn from the oil pipe between the cooler and the first benzene washer, used for washing the exhaust gases of the vacuum pump in counter-current in a separate washer, and then returned into the pipe conveying the main current of circulating oil.

2. The exhaust gases of the vacuum pump may be led into the gas main in front of the benzene washers, in which case the benzene is washed out with the bulk of the benzene from the coal gas.

3. The exhaust gases from the vacuum pump may be led through an absorption plant, where they are freed continuously from benzene by a suitable absorbent such as activated carbon or silica gel. S. W. C.

638. Improvements in or Relating to the Recovery of By-products in Coke Ovens or like Plants. Carl Still, assignee of Dr. Anton Weindel. E.P. 266,044, Feb. 14, 1927.

A process is claimed for the removal of phenols from the effluent water from coke-ovens. The condensate from the gas-cooling plant is treated with an organic solvent, at ordinary or raised temperature, to remove the phenols. The phenol-containing solvent is treated for the separation of the phenols either with an alkali or by distillation, and may be used again. Cheap solvents may be used, such as solvent naphtha, or high-boiling tar oils may be applied. G. S.

See also Abstracts Nos. 510, 511, 514, 599, 600 and 623.

Abstracts.

Arranged by W. H. Thomas, A.R.S.M.

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639. Baku. Azneft's Problems. (No author.) *The Oil Bulletin.* May 15, 1927, No. 10, p. 10.

The director of Azneft, M. B. Baranov, in an interview, has stated that the financial position for the current half-year leaves much to be desired. No dependance can be placed on the issue of credit for supplementary drilling and production. The combined strength of all Oil Trusts and the Oil-syndicate was successful in obtaining a credit of 60 mill. Rbls., of which 23 mill. Rbls. is Azneft's share. This is not satisfactory and will give a breathing space of only 2–3 months.

This financial difficulty will not permit the forcing of the programme of work, by which Azneft, during the 1926–27 operating year should produce 416 mill. poods (about 7 mill. tons), drill a total of 135 thous. metres, and have a throughput of 235 mill. poods (about 4 mill. tons).

There are grounds for believing that foreign firms will grant a loan to build, if not all the pipeline, at least the main section, Michaelovo–Batoum. A foreign credit of 6 mill. Rbls. has already been realised, which it is hoped to increase. The conditions of the loan, granted by a large Anglo-American firm, are both advantageous and acceptable, and if negotiations now in progress are successful work can be started and all problems of export and railway will be solved.

Progress in Refining

The half-year's activity of Azneft's refineries, as compared with the first half-year of 1925–26, shows an intensive expansion of the industry. The total throughput was 1,921.4 thous. tons, of which kerosine consisted of 55·2 per cent. and oils 44·8 per cent. The gross throughput exceeded by 13·6 per cent. that of the first half-year. This was due thanks to technical measures taken and to carrying out the rationalisation of production, as expressed in the increase of petroleum by-products extractions. The average extraction for the half-year equalled 6·19 per cent. of petroleum throughput, as against 3·68 per cent. for the first half of last year. In the present instance, beside the general technical improvements in the struggle with the evaporation of oil, a not insignificant rôle was played by the participation of light Bibi-Eibat oil in the amount of kerosine petroleum throughput—from 35·8 per cent. to 44·4 per cent.

The improvement in the benzine business is expressed in the large increase, from 5,213 tons in the first half of 1925–26 to 46,719 tons in the second half. Altogether for the half-year 90,335 tons were distilled, an increase of 56·9 per cent. on the corresponding period of last year. As a result of measures

taken the extraction of kerosine reached 28·1 per cent. in March. For the whole half-year 585.5 thous. tons of kerosine distillate were produced, of which amount 26.3 thous. tons were distilled into gas oil owing to the increased export of this last product abroad exceeding in volume the productive capabilities of its distillation without harming the kerosine. Upon rectification, 534.4 thous. tons of kerosine were obtained. The excess of production in comparison with last year amounted to 20·9 per cent.

Lubricating oils for the half-year were 451.8 thous. tons, an increase of 34·5 per cent. on the corresponding period of last year. The increase in ordinary lubricating oils (spindle, engine and cylinder) is expressed in a greater significant figure—42·5 per cent.

Electrification.

The erection of a line carrying current between Biely-Gorod and Ramani is approaching completion. The line, tension 100 thous. volts, is carried on iron masts 200 metres apart. When working, an uninterrupted supply of energy will be made to the oilfields, with a greatly decreased loss over the transmission lines. The total length is 10 kilometres.

Electrical Current to Poota.

The construction has begun of an aerial line about 13 kilometres long between Poota and Bibi-Eibat, with the intention of supplying the Poota oilfields with energy.

Hermetical Reservoirs.

With a view to improving the technical storage of petroleum, Azneft has at present hermetically sealed reservoirs of 60 thous. tons (3·6 mill. poods) capacity, and the erection of a further 38 thous. tons (2·3 mill. poods) storage is projected. For storing benzine hermetically sealed reservoirs of 20 thous. tons (1·2 mill. poods) are in existence, and other hermetically sealed storage capacity of 40 thous. tons (2·5 mill. poods) are in course of erection.

T. W.

640. Grosny. (No author.) *The Oil Bulletin*, May 15th, 1927. No. 10, p. 13.

A paraffin works, with a 1,000-poods paraffin capacity, daily commenced to function in Grosny on May 15.

Refinery in Tuapse.

The foundation was laid of a refinery and workmen's settlement in Tuapse on May 1.

New Pipeline.

The laying of a new oil 8-in. pipeline, length about 5 klm., was completed April 15 between 14 Section, V. Group of oilfields and the petroleum distilling plant No. 3a. The necessity of this work was called for owing to the S.S.O.E. increasing the Grosny production for the current year to 3 mill. tons, which increase falls exclusively on the V. Group. The existing pipeline, even at present, scarcely suffices to deliver petroleum to the refineries.

T. W.

641. Emba. Prospective Development of the Ural-Ernba District. (No author.) *The Oil Bulletin*, May 15, 1927, No. 10, p. 13.

The S.C.O.E. again point out that notwithstanding the significant potential possibilities of the district, its development is hindered by insufficient study and the necessity of a productive programme in conformity with the existing means of export. The existing storage station at Rakushy, through which

all Emba petroleum passes to Astrakhan, with some rearrangement, could at maximum pass through 665 thous. tons (40 mill. poods) yearly. This figure is proposed as a maximum production at the end of the first five years. To provide this amount the larger part of expenditure should be converted to augmenting prospective drilling and equipment of new oil plots, and only after this has been done should the erection of new refineries be entered upon. The capabilities of Embaneft's present refineries in Yaroslav and Nijni-Novgorod will be brought up to 300 thous. tons (20 mill. poods) by October 1. It would be more conformable to erect a new refinery with a capacity of 300 thous. tons, to be afterwards increased to 600 thous. tons, at Samara, which is a large centre. The prospective plan of Embaneft foresees the laying of an 8-in. pipeline 820 klm. long, with a throughput yearly of about a million tons from the oilfields to Samara. This pipeline could be completed only during the first years of the second five-year period, when the production will have reached 850 thous. or a mill. tons, which amount could be pumped through to Samara and distilled at the Volga refineries. At this level (1 mill. tons) the production could remain during a series of years, without any further large investments. The capital expenditure for the five years 1927–28—1931–32 is estimated at 60 mill. Rbls. It is proposed to cover this capital outlay by means of the Trust's internal accumulations, which, nevertheless, will be insufficient and Government assistance to the amount of 40 mill. Rbls. will be necessary during three years. With a view to increase Embaneft's resources and to decrease Government financing, the S.C.O.E. considers it conformable to reserve to Embaneft for the first five years the privilege of exemption from payment of royalties and the retainment at its discretion of profits.

T. W.

642. Grosny-Tuapse Pipeline. (General News.) *The Oil Bulletin*, June 1, 1927, No. 11, p. 14.

The length of this pipeline will be 618 klm., of which 30 klm. are already underground. About one-half of the number of pipes are ready at the railway stations alongside the pipeline track. As a large percentage of these pipes are damaged, Grosneft is applying the acetylene welding process. The pipeline will be underground, about 1·25 m. deep, only for the first 150 klm., and tarred. Above ground the insulation will be a patented mixture of sawdust and gudron. In passing over rivers the pipeline will either be laid across the river bed with an outer casing, or carried on consoles along bridges. In the neighbourhood of Mozdok a large marsh was encountered over which the pipeline passes on trestle bridges. One of the greatest difficulties was the River Terek, which carries down at high flood time up to 2,000 cub. m. of water. Taking into consideration the future development of the Vosnesensk district it was decided to erect a reinforced concrete bridge over this river at a cost of 600 thous. Rbls. This capital construction should be finished by August 1, 1928. The land over which the pipeline is laid is steppe and presents no great difficulties from Grosny to Armavir; nearer to Tuapsi rocky ground is met with where it will be necessary to apply explosives.

The pipeline will be constructed with 6 relieving stations, to be increased to 11 later on. Two Diesel motors with a third in reserve will be installed in each station, by means of which the pumping capacity will expand to 130 mill. poods of oil and distillate mixture. These Diesel motors are a temporary installation, the intention being to electrify the whole pumping plant in the future.

Thirty-two houses have been erected at four stations for staff and workmen, the complement for each station consists of 24–27 men. A telephone line has been erected along the whole pipeline.

In Tuapse the banks of the River Tuapsinky are to be strengthened to prevent inundation during high water, or a canal dug to the Black Sea. Oil storage reservoirs are to be erected 7 versts away from the refinery, in groups of 4 separated by stone walls as a fire precaution measure. The total cost of both undertakings—the pipeline and the refinery at Tuapse—is estimated at 65–70 mill. Rbls. T. W.

643. Important Contribution to the Study of Physical Processes of Refining Spirit, Kerosine, Paraffin and Lubricants. The Employment of Industrial Alcohol for the Refining of Petroleum. M. A. Guiselin. *Bulletin de la Société de Chemie Industrielle. Seventh Congress of Industrial Chemistry*, 1927.

Numerous hydrocarbons and complex organic compounds ordinarily met with in the products of bacteriological, chemical, physical, magnetic and catalytic transformation of natural materials constituting beds of bitumen and petroleum have, until recently, been considered as impurities. Certain of these react on the metal of apparatus used for storage, transport, or combustion, whilst others are detrimental to good lubrication or combustion in lamps, motors and generators. It is economically important that research should find some use for these by-products and losses. The necessity has been felt of isolating the impurities of mineral oils instead of destroying them by out-of-date methods of refining by oxidising acids. Fractional distillation should be such that the heat will not destroy these impurities, which are unfortunately unstable when heated. Their complex composition also prevents their complete or even sufficient separation.

M. Guiselin has frequently stressed the importance of the use of physical treatments by porous bodies, such as clays, bauxites or silicates. Another method of treatment analogous to these is that of Edeleanu, which refines oils by means of the solvent action of liquid sulphur dioxide. At a temperature of 15° C., sulphur dioxide dissolves practically all types of petroleum. This solution, however, can only be carried out in a closed vessel, owing to the vapour tension of SO_2 at this temperature.

If the solution be cooled, the operation can theoretically be carried out in open vessels, and one would then perceive the formation of two layers of different colour and non-miscible. An examination of the two layers shows that the lower one consists of SO_2 with aromatic, cyclic, naphthenic, unsaturated, oxygen and sulphur compounds in solution. These compounds are those usually considered as impurities and may comprise olefines, resins, asphalts, thiophenes, thiophanes, pyridine bases and organic acids, the whole being mixed with traces of paraffin hydrocarbons. The upper layer consists mainly of paraffin hydrocarbons containing a little SO_2 and impurities.

The burning oil fractions of paraffin hydrocarbons behave particularly well in lamps fitted with circular burners and wicks as used in France. The method constitutes an excellent physical process whereby good quality lamp oils may be separated from any crude kerosine.

It is only necessary to separate the two layers in order to obtain without loss, firstly an excellent lamp oil, and secondly, hydrocarbons charged with impurities. The SO_2 is reliquified after being evaporated off from the solutions.

The situation, however, has changed very rapidly for these by-products were employed in numerous ways.

The ease with which this method allows of the concentration of the major portion of aromatics contained in crude distillates, was made use of during the war in the manufacture of explosives by treatment of Borneo spirit. Again, the method furnishes a source of the least detonating of spirits, and also of a means of refining paraffin and lubrication fractions from crude mineral oils.

W. H. T.

644. Experiments in Wood Preservation. IV.—Preservative Properties of Chlorinated Coal Tar Derivatives. Leo Patrick Curtin and Marston Taylor Bogert. *Ind. Eng. Chem.*, 1927, **19**, 1231—1234.

Users of treated wood, particularly of sleepers, frequently require that the preservative should be an oil. It is believed that the moisture-excluding and fibre-binding properties of an oil are of assistance where the wood is subjected to severe mechanical shock. Heavy petroleum appears to be superior to creosote as a water-proofing oil and to be more permanent; it is also cheaper (in America) than creosote, which must be imported from Europe. Unfortunately, these advantages are offset by the fact that petroleum is non-poisonous to dry rot, while creosote is exceedingly toxic. For this reason the chief use of petroleum at present is as a diluent. A number of processes have been devised for the purpose of making petroleum suitable for wood preservation. These generally require the addition of a substance, highly toxic to wood fungi, to the oil. Substances proposed include copper naphthenate, oleate or resinate, oil-soluble compounds of arsenic, lead, mercury and zinc, and various organic substances such as dinitrochlorbenzene, dinitro-o-cresol, cresylic acid and β-naphthol. The last substance is, perhaps, one of the most effective, but owing to its low solubility in petroleum oils it is necessary to add pine oil to keep it in solution. The cost of the pine oil is, however, too expensive for general use.

Chlorination of the creosote and anthracene oil for wood preserving is not a new idea, but the present authors found that chlorination of the hydrocarbon portion of the creosote reduced its toxicity towards wood-rotting fungi. On the other hand, mono- and di-chlor derivatives of certain phenols besides being less volatile, less soluble in water and more resistant to oxidation, were also much more toxic than the unchlorinated parent substance. Chlorination of the cresols and xylenols gave the largest increase in toxicity, dichlorxylenol being the most toxic substance tested. The chlorination of tar acids boiling above 270° C. actually resulted in a decrease in their toxicity; this apparently being due rather to the decrease in the solubility of the substance in water than to lower toxicity. The chlor compounds produced were soluble in the asphaltic base petroleum employed by the authors and penetration tests gave better results with the solutions than with the oil alone. Tests of yellow pine treated with solution of 1–10 per cent. of chloro tar acid in petroleum are in progress. S. F. B.

645. The Petroleum Resources of Bolivia. The Bolivian Director-General of Mines and Petroleum. *The Petroleum Times*, Oct. 15, 1927.

The geographical distribution of petroleum in Bolivia can be divided into three districts, the one east of the Andean slopes; the central Andean district, and the low land of the Beni district. The oil-bearing areas of most importance are the foothills of the East Andean slopes. The occurrence of oil seepages and the outcropping of tar sands gave evidence that if suitable structures occurred, oil could be found in commercial quantities. This induced the Standard Oil Co. to begin drilling on a large scale.

The central Andean district is of less importance, as the geology is not supposed to favour large pools. Oil, if present, will probably be in the Cretaceous or older Palæozoic formations. It is believed that exploitations based on the careful interpretation of the geology of this district will eventually yield commercial production of at least modest proportion.

The Beni district is covered by quaternary æolian deposits and alluvium, so that the structure in this practically flat country cannot be mapped by surface observations and nothing can be said as to the future oil possibilities of this district, although oil seepages are known to exist in many places.

The Standard Oil Co. hold a blanket lease of about 5,000,000 acres in the Chaco Oriental, south-east Andes. These consist of rugged parallel ranges of hills rising 600 to 1,500 metres above sea-level with relatively narrow valleys. The ranges are heavily timbered, but the valleys are cultivated and clear of timber. Exposure of rocks can be found readily, but geological work is not easy. Plane table surveys are not practicable or necessary to delineate the structure. Strike and dip symbols and formation contacts are most efficient for mapping structure here. Transport facilities to points where drilling sites may be selected is a grave problem. The nearest railroad town is Tartagal, Argentine, though a line to Yacuiba is under construction. From here a national road leads north to Santa Cruz de la Sierra, but many great rivers have to be forded, and during the rainy season it is almost impossible to cross them. Drilling operations can be carried on all the year round, the climate being sub-tropical, but not unhealthy. Many oil seepages occur in the district; in general one occurs every 16 kilometres. The possible oil-producing horizons are the Lower Cretaceous and the Devonian, whilst oil has been found in the Tertiary, though this is probably migratory. The Cretaceous deposits consist of a heavy bedded sandstone at the base; a system of different shales with gypsum layers, limestone and dolomite; and an upper sandstone with a greater thickness than the lower one. The total thickness is 1,000 metres or more. They are overlain by Tertiary deposits, and rest upon the Devonian. These latter consist of a lower horizon, fossiliferous, consisting of micaceous sandstones, slate and schists of dark grey colour, or dark brown colour, sometimes ferriferous; and an upper horizon, without fossils, consisting of grey sandstones, sometimes yellowish or red, more or less hard in benches and layers. The total thickness may be 300–900 metres. In a few places, especially where faults occur, seepages of petroleum are present.

The district abounds in a wealth of structures which cut across the normal dip, which is S.E. In general, the long axis of the structures runs in a N.—S. direction. The Standard Oil Co. has drilled, or is drilling, 16 wells. Some of these have had to be abandoned. Of the producing wells the following are typical examples. No. 1 Saipuru is located on the Taputa Dome. The first producing sand was encountered at a depth of 256—268 ft. This was cased off, and drilling continued. At 495—507 ft. another oil and gas sand was encountered, with a daily capacity of 800 barrels. Finally, a third oil and gas sand was encountered at a depth of 2060–75 ft. No. 1 San Andite is located on Lot No. 7. It was started in August, 1925, and at 130 metres a sand was encountered with an estimated production of about 40 barrels. No. 2 Bermejo is located on an anticline, on the banks of the Rio Bermejo. On September 2, 1924, the well was finished at a total depth of 573 metres, and was considered as having an initial production of 1,500 barrels. All the producing wells are shut in at present and more territory is being tested.

S. W. C.

646. Silica Gel. *Journal of the Society of Chemical Industry*, Oct. 7, 1927.

The use of silica gel as an adsorbent for gases has been known for some time. The article describes its application to blast furnace practice.

The weight of air admitted to the furnace exceeds the total weight of all other materials charged to the furnace. Considerable attention has therefore been paid to the condition of the air. The importance of moisture is realised by the fact that air containing 5 grains of moisture per cubic foot—which is not excessive atmospheric humidity—contributes 100lb. of water to the furnace per ton of pig iron made. Previous attempts to reduce the moisture content by freezing or by chemical adsorption have not been successful. The silica gel plant described has been installed in the works of the Glasgow Iron

and Steel Co. at Wishaw. The plant is designed to treat 35,000 c. ft. of air per minute. About 2lb. of gel is used for each cub. ft. of air to be treated per minute.

The plant consists of six adsorber units, each of which is a steel box about 17ft. high, containing 10 mesh-bottomed trays on which rest 6 tons of gel in granular form. Running the whole length of the battery are 3 ducts, one along the inlet side and two along the outlet side, which are connected by branches to each adsorber. The branches from the entry duct are fitted with two-way dampers so that five are closed to the hot activating gas and open to the atmosphere, while the sixth closes one adsorber to the atmosphere and opens it to the entry of hot activating gas. The branches from the two outlet ducts are fitted with similar two-way dampers mechanically coupled with those on the inlet side of the battery. These dampers connect the one adsorber with the wet air duct and the five adsorbing units to the dried air duct. An induction fan draws the hot activating gas through the saturated gel and discharges the moisture through an uptake to the atmosphere. The heat for activation is provided by the combustion of blast-furnace gas, an excess of air being admitted to reduce the temperature to 338° C. The time required to activate one unit is about 1½ hours, during the latter part of which the gas is turned off and air only is drawn through to cool down the gel to a temperature at which it is able to adsorb moisture. A constant moisture content of about 1 grain per cub. ft. is aimed at. Since in cold weather the plant gives a degree of dryness below this, an adjustable inlet for atmospheric air exists between the dehydrating plant and the blower to dilute the dried air up to the moisture aimed at. S. W. C.

See also Abstracts Nos. 671, 758 and 763.

Chemistry of Petroleum.

647. Action of Refining Agents on Pure Sulphur Compounds in Naphtha Solutions. Merrill A. Youtz and Philip P. Perkins. *Ind. Eng. Chem.*, 1927, **19**, 1247–1250.

The desulphurising action of 95 per cent. sulphuric acid, aluminium chloride, silica-gel and other agents on representative sulphur compounds dissolved in straight-run cleaner's naphtha has been studied. The sulphides employed were chosen to represent all the types likely to be present in petroleum distillates and included ethyl, *iso*-amyl, *N*-*pri*-heptyl, *N*-4-*sec*-heptyl, phenyl, benzyl, allyl and tetramethylethylene sulphides. Disulphides were represented by ethyl and *iso*-amyl disulphides and thiophenes by the trimethyl- and trimethylethyl-derivatives. Mercaptans which offer little difficulty in practical treatment were not included. Solutions of these compounds in cleaner's naphtha were prepared to have an approximate sulphur content of 0·5 per cent. The results obtained with sulphuric acid, which was used in two treatments corresponding to 25 lb. per barrel for each treatment, showed that the action of the acid is mainly a solvent action. The lower sulphides and substituted thiophenes were readily removed but the aromatic sulphides and the disulphides were hardly affected. Tetramethylethylene sulphide was found to polymerise with strong acid, and as this became cloudy it was probable that some of the polymerised product passed back into the naphtha.

Aluminium chloride affected all the compounds with the exception of ethyl and *N*-heptyl sulphide. Only *sec*-heptyl, allyl, and benzyl sulphides reacted very completely, the effect on the remainder varying considerably. The disulphides were decomposed thoroughly and gave both mercaptans

and hydrogen sulphide. In order to study the relative effects on various compounds, the aluminium chloride treatment given was limited but in larger amounts it was found that nearly all the compounds reacted very completely. Silica-gel reduced the sulphur content of all the solutions tested. Under the conditions employed the removal was far from complete. Thiophenes were found to be least affected by this reagent and were followed by the disulphide and tetramethylethylene sulphide. Fuller's earth at 400° C. reduced the sulphur content of all the solutions fairly well with the exception of those containing the thiophenes. The experiments carried out, however, were limited in their scope and were not very conclusive.

Methyl iodide in the presence of mercuric iodide was found to be an excellent reagent for the removal of aliphatic sulphides from petroleum fractions of high or low molecular weight. The methyl iodide—mercuric iodide addition compounds are formed with considerable ease; they are very insoluble in the hydrocarbons present and generally separate as liquids. They are relatively far more stable than the addition compounds of the sulphides with methyl iodide or mercuric iodide alone. Certain disulphides also give addition products. The original sulphides can be regenerated from them by boiling with zinc and dilute acid; they can, therefore, not only be employed for isolating sulphur compounds from petroleum fractions but can also be used for the purification of the sulphides themselves. Attempts to reduce disulphides to mercaptans by sodium sulphide according to the equation $R_2S_2+2Na_2S=2RSNa+Na_2S_2$ were only partly successful.

A suggested procedure for the analysis of mixture of mercaptans, sulphides and disulphides is described. The suggested method depends upon the analysis of the oil for sulphur before and after treatment with various reagents, so that it would probably be accurate only for solution containing over 0·20 per cent. sulphur. Hydrogen sulphide is removed by sodium carbonate, free sulphur by concentrated aqueous sodium sulphides, mercaptans by alcoholic sodium plumbite containing lead sulphide, disulphides by the same reagent after reduction with alcoholic sodium sulphide and finally sulphides by methyl iodide—mercuric iodide. S. F. B.

648. A Study of the Products Obtained During the Treatment of Paraffin at 450° C., Both With and Without the Presence of Hydrogen: A Contribution to the Study of Berginisation. H. T. Waterman and J. N. J. Perquin. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry, 1927.

Research has shown that the spirits obtained by cracking and by Berginisation differ little with respect to distillation curve, for with both types of spirit there are peaks in the curve indicating the presence of pentane, hexane, heptane and noctane. There is only 3–4 per cent. of the hydrocarbons in the Berginised spirit, while there is even less in the cracked spirit. There are still further differences between the two types of spirit.

(1) The Berginised fractions and the residues from distillation are relatively stable. Even after twelve to eighteen months the refractionation of the various distillates shows little or no change.

(2) The products of Berginisation contain olefines, while hexane, heptane and octane constitute about 10 per cent.

(3) The cracked distillates are unsaturated to a far greater extent, they have a higher bromine value, specific gravity, refraction and dispersion, and a lower aniline number. The cracked distillates and residues are characterised by their lack of stability; their specific gravity and refraction increase rapidly.

(4) As the boiling points of similar fractions increase, the differences between Berginised and cracked spirits become more marked.

(5) It appears that in the cracked distillates, between the peaks of normal alphatic hydrocarbons, there are other types of hydrocarbons with a dispersion and proportionally lower bromine and aniline values. W. H. T.

649. Recent Research in Petroleum Chemistry. *Pet. Times*, Oct. 29, 1927.

The following is from the researches inaugurated by the American Petroleum Institute.

A study of the behaviour of the various petroleum fractions on distillation in atmospheres of hydrogen, nitrogen and carbon dioxide has shown least cracking to occur during distillation in carbon dioxide.

A still having a column of twenty plates, each with its own separate heater, and a series of condensers cooled to low temperatures has been constructed to operate with a CO_2 atmosphere. During the distillation of gas oil in this apparatus, some fractions, originally of a faint yellowish colour, remain unchanged in an atmosphere of CO_2 but develop a blue fluorescence in air, the change being catalysed by ultra-violet light. The reaction is apparently oxidation and the colours developed resemble those of lubricating oils.

The products obtained by submitting ethane to the silent electric discharge at 12,000 volts are 36·8 per cent. hydrogen, 21·8 per cent. methane with propane, butane and pentane. The reaction is thus similar to that when ethane is ionised by α particles from radon.

In an engine fitted with a device which eliminates the spark every fourth time it should occur, and a sampling valve which takes a sample of the unburned charge during each expansion stroke when the charge is not ignited either by spark or spontaneously, it was found that using tetraethyl lead, the ratio of carbon to hydrogen reacting with oxygen is greater than with undoped spirit. The difference is also greater for the engine covered with a carbon deposit and at high temperatures. These facts are supported by the earlier observation that a lead oxide deposit on the surface of carbon acts as a surface catalyst, which increases the rate of combustion of the carbon several times. Incidentally, it seems certain that the temperature of the residual exhaust is much lower than assumed by Goodenough and Backer in their calculations of efficiencies of internal combustion engines.

In an attempt to isolate the sulphur compounds present in high sulphur California crude, cold extraction by volatile solvents was resorted to. Small-scale experiments made showed sulphur contents of from ·07–·42 per cent., none apparently having a very selective action. The two most promising solvents, absolute ethyl alcohol and formaldehyde, were removed from the extracts by evaporation, the oil residues containing 2·17 and 3·72 per cent. sulphur respectively. Since the original oil contained 2·3 per cent. sulphur, it is evident that acetaldehyde preferentially dissolves the sulphur compounds.

The pyrolysis of several hydrocarbons has been studied in connection with the research on the non-catalytic decomposition of pure hydrocarbons and related compounds. The gaseous hydrocarbons were measured and passed through a pyrex tube, heated in an electric furnace. The unsaturated products were removed by bromination, after which the remainder was analysed. It was found that isobutane was decomposed at the rate of 1 per cent. at 500° C. and 16 per cent. at 600° C., the chief reaction at the latter temperature seeming to be a scission of the carbon to carbon linkage at the branched chain to give propylene and methane. At 700–750° C. aromatic formation is quite detectable.

In connection with the work on Allene, a new method for the separation and identification of acetylenes has been developed. The acetylene is absorbed in alkaline mercuric iodide, the derivative being quantitatively converted into the more easily identified iodo-acetylene.

A study of the reactions of olefines has shown traces of moisture to speed up the bromination in carbon-tetrachloride greatly. The reaction is also enormously accelerated by the action of sunlight. Iodine and bromine react more quickly with ethylene and propylene in acetic acid than in carbon tetrachloride or benzine.

By the reaction of two olefines with a quantity of oxygen insufficient to oxidise both, the following approximate relative rates were found :—

	Oxygen at high temperatures.	Permanganate in aqueous solution.
Ethylene	1	1
Propylene	1·7	—
Isobutene	3·1	1·8

Work on the isolation of nitrogen compounds from petroleum has been carried out on the sludge from sulphuric acid washing, as it is found that practically all the nitrogen passes into the sludge and is recoverable after dilution for recovery of acid. Pyrolle derivatives are to be expected, among them carbazole, and experiment shows this substance can be isolated from its solution in crude oil in amount corresponding to ·008 per cent. nitrogen.

Experiment or the action of sulphuric acid of strengths from concentrated to 30 per cent. sulphur trioxide on hydrocarbons show oxidation to be more marked by increase of temperature than of sulphur trioxide. In all cases some action was noted, but great difficulty has been met in obtaining checking yields of sulphonated products. This is believed to be mainly due to methods of isolation. A. R. S.

650. Synthesis of Paraffin Hydrocarbons from Carbon Monoxide. Fischer and Tropsch. Ber. d.D. Ch. Ges. June, 1927.

In previous work the authors have obtained heavy hydrocarbons under atmospheric pressure conditions. When they studied the reaction at pressures of 10–15 atmospheres they found a considerable increase in the amount of heavy non-volatile compounds remaining in contact with the catalyst.

A horizontal pressure tight glass tube 13 × 500 mms. was filled for a distance of 30 cms. with 30 gms. of a catalyst consisting of four parts of iron and one part of copper impregnated with ½ per cent. K_2CO_3, and maintained at 280° while water gas was passed through at 10–15 atms. After a considerable time the efficiency of the catalyst was destroyed owing to the complete choking of the tube by the non-volatile reaction products. The amount adhering to the catalyst amounted to 100 per cent. of its weight.

The mass had to be removed from the tube by means of a steel borer and extracted with organic solvents, when petroleum ether only extracted the lower melting compounds, while benzol and toluol extracted the heavier compounds also.

The mass crystallised pure white, as a starchy mass, dissolved in hot and to a slightly smaller extent in cold benzene xylene and chloroform, melted between 90–108° C. (no increase on recrystallisation) had a molecular weight of 1000 and the analysis corresponded to the formula $C_{70}H_{142}$. In the strongly

exothermic reaction between carbon monoxide and hydrogen, therefore, the tendency is for the formation of compounds of very high molecular weight.
A. R. S.

651. Method of Maintaining the Stability of Dibasic Calcium Hypochlorite. I.G. Farbenindustrie Aktiengesellschaft. E.P. 276,307. Oct. 27, 1927.

The dibasic hypochlorite of the formula $2Ca(OH)_2Ca(OCl)_2$ obtained as hexagonal granular prisms by the method described in specifications 8476/1907 and 182,927 is freed from calcium chloride and mother liquor by centrifuging. It is then kept in this state containing 5–15 per cent. of moisture when the available chlorine originally 40 per cent. is only reduced to 36–37 per cent. in one month at 45° C. A. R. S.

See also Abstract No. 758.

Crude Oil.

652. Meeting Sulphur Oil and Gas Problems. *Oil and Gas J.* Nov. 10, 1927.

The methods are devised for handling West Texas crudes, the gases from which are highly objectionable, both oil and gas being highly sulphurous.

If the crude is run in shell stills, caustic soda solution is flowed into the stills by gravity with the crude, the amount being regulated by a float. Cracking stocks are mixed with caustic solution through small chemical pumps connected to the charging pumps and the mixture is pumped into the tubes. The vapours are mixed with ammonia either aqueous or anhydrous in dephlegmators or bubble towers. Where special alloy tubes are used, protection is given by placing a splash plate opposite the entrance of the vapours and circulating sufficient water to dilute the ammonia.

Highly sulphurous gas is treated by flowing through towers containing baffles of wood over which brine containing iron oxide is pumped. From here it is blown to an "actifier" tower also containing baffles where the sulphur is deposited on the baffles. Thus the gas is delivered 90 per cent. free from the carbon and sulphur which cause the trouble. A. R. S.

See also Abstracts Nos. 686, 701, 708, 709, 711 and 757.

Natural Gas.

653. Characteristics of Vapours Evolved During Evaporation of Gasoline. J. J. Delaney. *Refiner.* Oct., 1927. 63.

A description of a test carried out on the evaporation of an unstabilized natural gasoline. A quantity of this was allowed to evaporate over a period of 22½ hours from a 10,000 gallon tank. The characteristics of the evolved gases and of the gasoline before and after the test were determined. The evolved gases were composed chiefly of propane and butane. R. P. L.

654. Absorption Plant. Braun. U.S.P. 1,640,747. Aug. 30, 1927.

The plant is designed for the recovery of casing head gas. Stripped absorption oil is constrained to flow through a packed tower up which the gas is

flowing. The saturated oil is then drawn off, passed through a heat exchanger into a still where open steam causes the evolution of the gasoline as vapour. From here the stripped oil is passed back through a heat exchanger to raise the temperature of the incoming oil, thereafter through a gasoline condenser, where its temperature is raised and then passed through a control fractional condenser and then returned to the absorption tower. At the same time the vapours from the still are passed through a primary fractionating condenser, where they raise the temperature of the saturated oil passing to the still. After this the vapours pass through the fractionating control condenser, where a further transfer of heat is made from the gases to the denuded oil. Finally the vapours pass to the primary gasoline condenser. A. R. S.

655. Recovery of Gasoline. Herthel and Tifft. U.S.P. 1,648,585, Nov. 8th, 1927. Compare Bernard, U.S.P. 1,560,137, Nov. 3, 1925.

The invention relates to the recovery of gasoline from solutions obtained by absorbing the low boiling hydrocarbons from natural gas in suitable liquid media. The solution is first distilled with or without increased pressure and the pressure on the mixture of vapour and liquid in the distillate is then reduced by discharge through a liquid column. The pressure reduction corresponds to the hydrostatic head of the column. Further scrubbing is effected by circulating the liquid portion of the distillate in counter-current flow in contact with the uncondensed vapours. A detailed description of suitable forms of apparatus is given, together with diagrams. R. P. L.

656. Eliminating Sulphuretted Hydrogen from Gases. C. Still. E.P. 271,805. Aug. 4th, 1926. Conv., May 25, 1926.

A cyclical process for removing sulphuretted hydrogen from gases in which an aqueous suspension containing ferrous and ferric hydroxides or carbonates is utilised for washing the gases and is then regenerated by treatment with air which is forced from below into the suspension. In order to recover elementary sulphur in a concentrated form a suspension containing not more than 2 per cent. iron is employed in the circular path, the sulphur containing foam floated off from the regenerator being treated in a separate vessel. The process may be adopted to obtain highly concentrated solutions of thiosulphates by rendering the wash liquid alkaline either by added sodium hydroxide or carbonate or by the content of ammonia in the gas. The installation for carrying out the cyclic process consists of an arrangement in series of a scrubber for washing the gas, a relatively high oxidising tower into the bottom of which the liquid containing the matter in suspension flowing from the scrubber is forced and into which the oxidising air is introduced at the same time. A receptacle connected to the upper end of the oxidising tower is adapted to receive and then to separate the suspension consisting of iron and sulphur as a foam. H. S. G.

See also Abstract No. 646.

Motor Spirit.

657. Modern Motor Fuels. *Automobile Engineer.* Nov., 1927.

The results are given of laboratory investigations on eighteen motor fuels at present on the market. The highest useful compression ratio of each fuel was ascertained on a Recardo E 35 engine at Cambridge University;

chemical analysis was carried out by Dr. W. R. Ormandy. The following is a précis of the results:—

Fuel.	HUCR.	Approximate analysis. Aromatics.	Naphthenes.	Unsaturateds.	Paraffins (by diff.).
Red Line Super	5·05	5·7	—	—	—
Red Line Commercial ..	5·03	6·3	39·5	1·3	52·9
Shell No. 1	4·76	7·4	—	—	—
Shell No. 3	4·63	9·3	29·7	1·8	59·2
Power	4·73	3·2	36·5	3·2	57·1
Pratt's Perfection	4·61	6·7	—	—	—
Pratt's Gasoline	4·655	nil	22·2	17·6	60·2
Glico	4·54	nil	20·5	17·9	61·6
Russian Oil Products ..	4·52	4·8	37·3	1·0	56·9
British Petroleum No. 1 ..	4·46	11·9	—	—	—
British Petroleum No. 3 ..	4·46	13·2	20·3	0·7	65·8
Blue Bird Private	4·36	4·4	21·9	3·4	70·3
Blue Bird No. 3	4·59	5·0	35·0	0·8	59·2
Dominion	4·315	5·9	25·0	1·4	67·7
Pratt's Ethylised Petrol ..	5·25–5·34	5·3	12·5	12·2	70·0
Red Line Benzol Mixture ..	5·14	17·4	35·6	1·1	45·9
Pratt's Benzol Mixture ..	4·98	23·4	24·4	7·4	44·8
National Benzol Mixture ..	4·875	34·2	—	—	—

W. N. H.

658. A Study of the Light Distillate (Coal and Shales) rich in Ethylenic Hydrocarbons. M. R. Garnaut. A Study of the Adiabatic Combustion of Fuel Mixtures. M. A. Pignot. A Study of the Speed of Propagation of Combustion in Carburetted Mixtures. M. R. Duchêne. Engine Tests of Various Fuels. N. N. P. Clerget and R. Moutte. *Bulletin de la Société de Chemie Industrielle.*

These researches are a study of the "practical" properties of hydrocarbons suitable as motor fuels. The communication of M. Pignot concerns in particular the influence of antidetonants on the temperature of adiabatic combustion. That of M. Duchêne deals with the first phase of propagation at the commencement of the flash, in mixtures of air and benzene.

The work of Clerget and Moutte observed on a variable compression engine has given practical results, whereby laboratory data can be correlated with thermodynamic properties. W. H. T.

659. The International Aspect of Alcohol Fuels. M. Ch. Petrlik. Some Considerations of the Internal Combustion Engine. M. Paul Dufour. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry. 1927.

The injection of fuels in Diesel engines without a compressor.

Mechanical injection with liquid accumulators.

Supercharging.

Results of tests on heavy oil engines.

Improvements in the combustion of hydrocarbons by means of nascent oxygen.

Last year, the author published the first results obtained on the combustion of hydrocarbons by their treatment with certain terpenes.

This year, the choice of terpenes has been restricted and from the results of preliminary oxidation, it has been possible to increase the results obtained.

Results of the official tests of the Belgian Government :—

(1) On motor car, 50 per cent. kerosine + 50 per cent. spirit + small quantity of "Targol" (oxidation product of terpenes)—43 per cent. economy.

(2) On aeroplane engine using (*a*) "Targol" spirit—more than 20 per cent. economy.

(*b*) 25 per cent. kerosine + 75 per cent. spirit + small quantity of "Targol" about 20 per cent. economy.

The official figures will be published at the same time as the communication. After the "targolisation" of the fuels, it was found that there was a greater conservation of lubricating oils. W. H. T.

660. Petroleum-Refining Process and Reagent for the Removal of Sulphur. F. C. Axtell. U.S.P. 1,645,679, Oct. 18, 1927.

Fuming sulphuric acid is saturated with an aromatic hydrocarbon to yield a reagent which when blended with free sulphuric acid is capable of removing sulphur from hydrocarbon distillates. The action is twofold, the reagent partly removing some of the sulphur as a sludge and partly acting by polymerizing the sulphur-containing bodies to higher boiling compounds which may be removed by distillation. It is claimed that this reagent has little polymerizing action on unsaturated hydrocarbons and virtually no oxidizing or sulphonating action on these or on aromatic hydrocarbons. It is therefore especially valuable in the refining of cracked spirit. In practice after removal of the sludge, the oil may be treated with clay, agitated with alkali and distilled. R. P. L.

661. Motor Spirit. C. K. Reiman. E.P. 253,131, Sept. 5, 1927.

The use of unsaturated bodies as an anti-knock spirit is claimed by the patentee. The unsaturated bodies are formed by vapour phase cracking and are blended with straight run gasoline in the proportions of 40 to 15 per cent. cracked spirit. The resulting blend must deposit more than 100 mg. gum from 100 c.c. spirit in the copper dish test in order to fall within the patent. W. N. H.

662. Motor Fuels. W. B. D. Penniman. E.P. 257,886, Sept. 2, 1927.

A vertical pressure still 4 feet diameter, 26 feet high is mounted so that the base can be heated in a furnace. 950 gallons Mid-Continental gas oil fills the lower half, the oil temperature was raised to 260° C., pressure was maintained at 300 lbs./sq. in. and 300 cubic feet/minute of air preheated by coils in the upper half of the still was blown through the oil, the temperature of which rose to 380° C. Distillation began, the volume of the still contents was maintained by pumping in fresh oil preheated in coils arranged in the top half of the still. The following hourly input and output was maintained —160 gallons oil pumped in giving carbon dioxide and water equivalent to 7 gallons oil, volatile uncondensable hydrocarbons, equivalent to 1 gallon oil; water soluble organic compounds equivalent to 10 gallons of oil composition, acetaldehyde and solvents to 80° C., 67 per cent., acid and gum 33 per cent.; gasoline distillate equivalent to 93·2 gallons oil yielding more than 80 gallons finished gasoline; carbon equivalent to 4 gallons oil; oil returned to system 40 gallons after carbon separation, 16 gallons from gasoline distillate.

The "intermediate distillate" obtained separated fairly sharply into two layers, the lower one being water and water soluble substances. The upper layer is separated, washed with 3—10 per cent. water and the washing added to the lower layer. The water insoluble upper layer can be freed from aldehydes, acids and phenols by treatment with caustic soda, sodium carbonate or sodium bisulphite. A small acid treatment followed by dry distillation is

carried out to give a spirit with 437° F. end point; up to 90 per cent. of end point spirit can be thus obtained from the separated layer. This spirit has a characteristic odour and an oxygen content of about 3 per cent., it has a high anti-knock value and is miscible with 95 per cent. alcohol, gasoline, benzol or acetone. The acid sludge obtained above yields alcohol on hydrolysis. A variety of methods are described for treating the crude water-insoluble distillate.

The water-soluble distillate was found to contain 18 per cent. of organic matter made up of acids 3 per cent., aldehydes 7 per cent., ketones 3 per cent., alcohols 5 per cent. The distillate was split into 12 fractions by a good fractionating column, fractions 1 and 2 consist of almost pure acetaldehyde, fractions 3—12 were treated with caustic soda and redistilled, a "white solvent" B.P. 45—85° C. was obtained amounting to about ⅔ of the total organic matter in the aqueous solution, it is miscible in all proportions with water, alcohol, ether, benzol and petroleum and has anti-knock properties, it is also a solvent for shellac, gums, nitrocellulose and other cellulose esters.

The neutral or alkaline still residue remaining after the white solvent had been distilled off was acidified and steam-distilled. The residual gum may be combined with aniline, hydrazine or phenol; the gummy liquid if dried can be hardened as desired.

The process applies to general hydrocarbon mixtures of low grade such as crude petroleum and distillates, shale oils, etc.; coal, coke or peat may be suspended in the oil. When applied to sulphurous oils a certain proportion of the sulphur may be removed as sulphur dioxide which may be employed to form sodium bisulphite. By suitable manipulation the finely divided carbon at first formed may be preferentially oxidised and removed from the liquid phase.

Catalysts may be employed in the still such as aluminium chloride, oxides of manganes, lead iron chromium, vanadium, zinc, etc.; but in general these are not necessary for crude oils, but rather for the residue from some cracking process or coal tar distillates.

If the action becomes too vigorous, steam or flue gases may be mixed with the incoming air; or, on the other hand, it may be enriched with oxygen when treating a resistant substance.

In order to obtain a particular product from a suitable substance the critical range of pressure and temperature must be found over which that desired product is produced in the reaction vessel.

After the initial warming up the process becomes self-supporting as regards temperature of the reaction vessel. W. N. H.

See also Abstracts Nos. 643, 647, 655, 663, 695, 713, 725 and 729.

Kerosine.

663. Many Factors in Treating Light Oils. A. Henriksen. *Oil and Gas Journal*, 1927, **26**, No. 21, 130–131.

A description is given of the equipment employed by the Marland Refining Co. for the refining of light oils by plumbite. This consists of a batch circulating system, the oil being drawn from the bottoms of cone bottom agitators by centrifugal pumps, passed through mechanical mixers, and from there returned to the top of the agitators. The mixers attached to each agitator consist of three 8-ft. lengths of 24-in. pipe fitted with heads and stuffing boxes at the ends; they are held in a horizontal position by means of a steel cradle.

Each mixer is fitted with a stirring device in the form of four 4-bladed propellers mounted on a single shaft in such a manner that each propeller acts in the reverse direction to the one preceding it. The shaft rotates from 100–150 revolutions per minute, so that very thorough mixing is obtained and the entire contents of the agitator can be circulated in a very short time. Gasolines containing a considerable quantity of hydrogen sulphide are given a preliminary soda wash, which not only economises in plumbite but also decreases the time by the plumbite for sweetening. It also enables a more exact control of the sulphur treatment to be made. Two conditions having an important bearing on the production of stable and non-corrosive products were found to be: (*a*) removal of all lead sulphide, sulphur or sludging material from the washer between one treatment and the next and (*b*) prevention of the accumulation of sulphurous scale in the run tanks. The rôle played by the lead sulphide produced in the sweetening is an important one, for not only does the sulphide adsorb sulphur compounds from the oil, but on oxidation it readily forms compounds from which fresh plumbite can be regenerated. It is on this property of the sulphide that the reclamation process depends. The importance of laboratory control throughout the whole treatment is emphasised, particularly the control of the sulphur added to bring about separation of the lead sulphide. The treatment of pressure distillates presents greater difficulties than the refining of straight run gasolines. Acid treatment, to avoid gumming, is general but always entails re-running or heat treatment of some kind. Various methods for treating pressure distillates are employed: (1) Single plumbite treatment in which the distillate, after an acid wash, is washed with water, neutralised and sweetened by means of plumbite and finally steam distilled. (2) The double plumbite process, which differs from (1) in that a preliminary plumbite treatment is given before the acid. (3) A process in which the distillate after a light acid treatment is water washed, neutralised with soda and run through Gray towers. The last method, which is stated to give very stable products, is fully described. The acid treatment varies with the distillate and is from 2–8 lb. of 60–62° acid per barrel. After water, a good wash with 8° caustic soda solution is given to neutralise the acid and the distillate run through Gray towers packed with 60–80 mesh fuller's earth. The polymers collect and are continuously removed from the clay; they form about 0·5 per cent. by volume of the pressure distillate treated, or 0·8 per cent. of the finished gasoline. The gasoline leaving the Gray towers finally receives a soda-ash wash to remove sulphur dioxide which is formed by the decomposition of sulphur compounds. The finished product has a stability varying from 30 to 25 colour during four hours' sunlight. Gasoline produced in the Cross plant is refined by plumbite after it has passed through Gray towers. The vapour from the Cross bubble towers, adjusted to give end-point gasoline, are led directly into towers containing an 8-ft. layer of 30–60 mesh fuller's earth. The net loss due to polymerisation is 0·8 per cent. The gasoline from the towers contains sulphur dioxide, which is removed by injecting soda ash solution into the condensers. The finished Cross gasoline after sweetening has a stability equal to that of the acid treated pressure distillate described above.

Sodium and calcium hypochlorites are also employed for refining straight run distillates. The treatment is given after a soda wash, and the sodium hypochlorite solution used contains from 5–8 gms. available chlorine and 3–5 gms. free caustic soda per gallon.

The sweetening of distillates in the vapour state by the use of copper oxide has been accomplished and is at present receiving great attention. In the author's opinion, however, plumbite is the most practicable and economical method of sweetening at present employed. S. F. B.

664. Process for Purifying Hydrocarbon Oils Containing Sulphur. Standard Development Company. E.P. 270,626. Oct. 20, 1927.

The sour hydrocarbon oil is treated with sulphur in the presence of a preformed heavy metal sulphide, preferably lead sulphide, and an alkali, usually aqueous sodium hydroxide. The mixture is agitated in air with sulphur amounting to one half the mercaptan sulphur present, whereby the mercaptans are converted to polysulphides. The oil may now be treated with 66° Be sulphuric acid, or preferably distilled at a temperature not above 320° F., when the still bottoms contain a highly sulphurous residue and the overhead distillate is sweet and low in sulphur. A. R. S.

See also Abstracts Nos. 643, 681 and 682.

Fuel Oil.

665. Fuel Economising Product. A. Civier. E.P. 277,864, 1927.

The product consists of a mixture of 30 litres of water, 30 kilograms of sodium chloride, one kilo of tallow and one kilo of oil (thick unused or waste machine oil), the whole being boiled together several times and a further 70 litres of water added. A colouring matter may also be added. The material is sprinkled on the fuel as required. H. G. S.

Lubricating Oil and Wax.

666. Advantages of Contact Filtration. Bierce. *Oil and Gas J.*, Sept. 29, 1927.

The term "contact filtration" has been adopted to mean the use of fine clay or earth generally at elevated temperatures either in the acid or neutral stage in the refining of oils or waxes. Among the advantages of clay are, that practically all oils may be treated in the acid stage, thus obviating the use of water and alkali. One man can handle an entire batch, as he can heat, apply the clay and then pump same through the filter press. In the case of steam cylinder stocks, which must be cut back with naphtha for dewaxing, the filter press may be done away with, as the clay readily settles from the non-viscous solution and the final traces can be removed by filtration through sand. Oils made by this process usually show a higher viscosity than those made with coarse earth percolation, especially when the treatment is given in the acid stage. Where old plant previously used in the percolation process is installed, the old gravity filters make good mixing tanks and heaters, if it is intended to use only moderate temperatures. On the other hand, a contact process plant only takes up about half the space required for the older percolation plant.

The most desirable method of intimately mixing the clay and oil seems to be by passing through a heater and centrifugal pump in series. The use of open steam, after the oil has reached a sufficiently high temperature to prevent the condensation of droplets which inhibit the efficiency of the clay, seems to be advantageous, preventing as it does to a great extent the oxidation of the oil. A. R. S.

667. Deterioration of Mineral Oils. Brian Mead and Collaborators. *Industrial and Engineering Chemistry*, No. 19, p. 1240.

The paper deals with the mechanism of oxidation as determined by a static method, in either an open or closed system. The first consists in heating samples of oil in test tubes the mouths of which are open to the air by placing a batch of such tubes in an air oven maintained at a constant temperature. Fairly satisfactory and concordant results can be obtained, but only the effects

produced by oxidation can be measured and not the amounts of oxygen producing them. A more satisfactory method seems to be to have the oil and oxygen in an enclosed space, then the amount of oxygen absorbed can be determined by actual measurement. The only disadvantage this method has is that it requires a separate apparatus for each determination. The paper is divided into three sections. Part A includes the results from the closed static method studying the effects of temperature, surface exposure, degree of unsaturation of the oil, acidity development and sludge formation; part B of a series of accelerated tests on Nujol and a commercial transformer oil by the open static method; and part C a study of the effect of various antioxidants on the sludge formation in transformer oils as determined by the open static method.

Part A.—Oils are rarely exposed to temperatures greater than 100° C. in transformers, but at this temperature oxidation is relatively slight. At 200° C. there is not only considerable fire hazard from both the sample and heating bath, but it is difficult to maintain the heating bath. It was decided to operate at 130° C. Bulb heaters were employed and efficient stirrers were installed so that the temperature throughout the bath was constant within 0·5° C. It was found that the rate of oxygen disappearance was constant, whilst the rates of acidity and sludge formation were slow at the start and became higher as the reaction proceeded. The physical and chemical properties of the oils used in the test are tabulated. Not only are the tests carried out at a higher temperature than that to which transformer oils are usually subjected, but it is possible that at such elevated temperatures there is a different mechanism in the deterioration from that at lower temperatures. This was shown to exist by the following experiments: Equal samples of the same oil were heated in dishes of the same diameter for the same length of time at 130° C., 140° C. and 150° C. respectively. At 130° C. and 140° C. sludge was formed, but none of it was insoluble in CS_2. At 150° C., however, not only was a larger amount of it formed but 37 per cent. of it was insoluble in CS_2. By experiment the temperature co-efficient of oxygen absorption between 120° C. and 130° C. was found to be 2·4 per 10° C. This high value shows that diffusion of oxygen into the oil is not the controlling factor. In none of the experiments was the oil sample agitated. It was found that when the ratio of square centimetres exposed to oxygen per gram of oil was varied from 0·2 to 0·4 the same oxygen disappearance per gram of oil was noticed in a given time. This means that, under these conditions, the rate of solution of oxygen in the oil was greater than the rate at which oxygen was being used up in oxidising the sample. With increased temperatures not only will the rate of oxidation increase but the solubility of oxygen in the oil will decrease. Even at 130° C. there is some tendency for the surface exposure to become controlling, while at 150° C. the results indicate that this is undoubtedly the case. Probably the most important of the other variables is the chemical unsaturation of the oil being used. There was no strict proportionality found between the degree of unsaturation of the oil and its oxidisability, although the general trend of results was to show a greater rate with a greater degree of unsaturation. The ratios of unsaturation to rate of oxidation indicate a satisfactory constancy for each class of oil. A correlation of the acidity developed with the amount of oxygen absorbed by the oil and also with the sludge formed during the same period was undertaken. The experiments were carried out at 120° C. The oil was exposed to oxidation for a given time, obtaining the increments of oxygen absorption at intervals. The acidity of the sample was then obtained by direct titration, the sludge being evaluated at the same time. The acidity-time curve shows some evidence in support of the theory that the reaction is autocatalytic. It starts

very slowly, proceeds at an increasing rate for some time, and eventually slows up again. If the acidity is plotted against the corresponding amounts of oxygen absorbed, the curve has a distinct "S" shape. This means that at first oxygen is absorbed more rapidly than acidity is developed by the sample, but after a certain amount of oxygen absorption acidity starts to develop at an increasing rate, being catalysed by the products of oxidation, and then eventually falls off again. The curves of sludge formed against time and against amount of oxygen absorbed show that sludge formation starts at a very low rate and increases throughout the period of the tests. This may show the reaction to be autocatalytic, but the experiments have not, however, disproved the contention that sludge formation is promoted by acidity. It is possible that soluble sludge is formed at a constant rate, but that by reason of acidity development it is either polymerised and so rendered insoluble, or that it was rendered insoluble by the acid in the mode of its formation. The sludge acidity curve shows that at first acidity is developed faster than sludge is formed, but that very soon the rate of sludge formation commences to increase and so continues for the remainder of the experiment.

Part B.—All tests were conducted at 150° C., the samples being placed in test-tubes in an oil bath within an air oven. The criteria of deterioration were acidity development and sludge formation. Nujol was first used in order to develop and test the method of experimentation. With this the acidity-time relation can be satisfactorily represented by a straight line. No sludge was formed during the period of test. The majority of the tests were performed on a sample of commercial transformer oil (No. 10 Transil Oil), of which both a new sample and one which had so deteriorated as to be discarded were available. The results of the tests showed that acidity development is autocatalytic at low initial acidity, but not at relatively high initial acidities, which were obtained by additions (up to 5 per cent.) of deteriorated oil. Further, that sludge formation also seems to be greatly influenced by the initial acidity of the oil, much more sludge being formed at high initial acidities (obtained by additions of deteriorated oil) than at the low acidity of the new oil.

Part C.—The criterion of deterioration was sludge formation. The method used was the same as in part B. The sludge developed after 130 hours' heating of the oil at 130° C. was determined by filtration through a Gooch crucible and washing with petroleum ether until the filtrate was free from oil. The sludge was then dried to constant weight at 110° C. in an air oven. Of 177 substances tested, 48 showed themselves capable of having an inhibitory action on sludge formation. The remainder either have comparatively little effect or else accelerate the reaction, the majority being in the second category. Of those having the greatest inhibitory effect, three stand alone: sulphur, nitrocresol, and nitrobenzene. It seems to be quite impossible to draw any generalised conclusions from the results as to the types of compounds which act as antioxidants, since for every compound which acts as a negative catalyst one of the same types can readily be discovered which acts as a positive catalyst. The action seems to be specific and not to follow any general rules by which the action of any particular substance might be predicted. S. W. C.

668. A Study of the Pyrogenation of Mineral Oils. By M. G. Dixmier. A Study of the Action of Sulphuric Acid on Mineral Oils. By M. Cornet. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry. 1927.

In following the improvements and applications of methods of identification for mineral oils, the Aeronautical laboratory continues the study of tests

dealing mainly with the "practical qualities" of these oils. The resistance to alteration by pyrogenation plays an important part from this point of view. M. Dixmier has undertaken to examine a series of mineral oils with regard to their viscosities, asphalt and paraffin contents, before and after prolonged heat treatment at 150° C. The work of M. Cornet verifies the absence of parallelism between the deposits obtained by the action of sulphuric acid, and by pyrogenation of oils. He confirms that the percentage of tar cannot be taken as an evaluation of resistance to pyrogenation.

W. H. T.

669. The Application of Low-pressure Distillation and Rectification. By M. Fichoux. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry, 1927.

(1) *Theoretical considerations.*—(*a*) A lowering of pressure lowers the boiling-point during distillation, and avoids decomposition. It permits heating by steam and obviates or reduces the injection of open steam during the distillation of materials non-miscible with water. (*b*) The equilibrium conditions can be varied between the components of a liquid and those of a vapour which it emits, when it is a question of rectifying mixtures comprising an azeotrope. An examination has been made of the various methods of heating during distillation (without vacuum) of materials of high boiling-point and of the possibility of heating with saturated steam the products boiling up to 250° C. (@ 760 m.m.). Superheating combined with the use of vacuum reduces the consumption of open steam when the boiling-point is over 250° C. It is necessary to employ vacuum as a general rule, for the co-efficients of enrichment are increased by vacuum. These co-efficients are the functions of which the values for a mixture are the curves of the level of the surface of vaporisation $\beta(C+p)=0$. If one can determine the direction of these curves of the level of the surface, the advisability of using vacuum can be decided upon. Calculations must be made concerning vacuum distillation or rectification apparatus, there being a necessity for a hyperbolic curve in order to maintain a constant class of charge in the various trays (perforated trays are inconvenient).

(2) *Some applications in various industries.*—(*a*) The rectification of intermediate products in the dyestuff industries (nitrotoluene and nitrochlorbenzene). (*b*) The rectification of the components of petroleum. (*c*) The topping of oils used for gas absorption. (*d*) The extraction of glycerine. (*e*) The rectification (under vacuum) of azeotropic mixtures and the manufacture of absolute alcohol by this method.

W. H. T.

670. Evaluation of Transformer Oils. J. G. Ford. *Ind. and Eng. Chem.*, October 19.

Transformer oil serves two purposes. It acts as an insulator and also carries away the heat generated in the transformer windings. The first of these services is unaffected by "sludging" of the oil, the sludge being to all intents and purposes as good an insulator as the oil. A layer of sludge on the windings helps to retain the heat instead of dissipating it, and the consequent overheating is in itself a factor in favour of an increased sludge formation. Some oils, chiefly the water-white type, do not produce sludge to any extent, but produce instead a number of organic acids, some of which distil off at the working temperature. The various tests for the suitability of an oil for transformer use are unsatisfactory. It is difficult to reproduce results, and the tests do not agree well among themselves. The author believes that a better solution of the problem lies in obtaining some knowledge of the constitution of an oil and correlating this with a knowledge of the behaviour of

the constituents towards oxidation. This paper describes the work performed in examining oils on this basis. The oxidation tests were performed by heating 500 c.c. of the oil for long periods at 80° C., 100° C., 110° C. and 120° C. The percentage of sludge and the neutralisation values were determined periodically. The unsaturated hydrocarbons were determined by shaking 15 c.c. of conc. sulphuric acid and 10 c.c. of oil for 30 mins., and centrifuging for 10 mins., the volume decrease of the oil being read. The oil was alternately shaken and centrifuged until there was no further decrease in volume, the time taken being 2—3 hours. This method gives easily reproducible results. To obtain the total percentage of unsaturateds the percentage obtained by nitration should be added. Tests showed that the tendency to sludge increases with an increased sulphuric acid absorption value as determined above.

In order to determine the quantity of naphthenes the aniline point was taken, and this was then compared with the aniline point of a "pure paraffin oil" of the same viscosity. The latter value was obtained by treating Pennsylvanian oil with oleum. The resulting oil was then distilled under reduced pressure into ten fractions, and a curve was plotted showing aniline point against viscosity. Experiments show that the higher molecular weight naphthene compounds have an anti-oxidising effect, and an oil containing a large percentage of such compounds gave excellent results both from the point of view of sludge and acid formation when tested. Curves are also given showing the effect of acidity and variation of temperature on sludge formation. With reference to the last graph the author concludes that certain oils will give a false result if the oxidation tests are carried out at any temperature but that approximating to working conditions. P. D.

671. Auto-motive Lubricants. L. W. Parsons. *Ind. and Eng. Chem.*, October 19.

This paper describes briefly the processes and problems of lubricating oil production. The research problems which have yet to be solved are discussed, particularly those brought forward by Dunstan and Thole—namely, the desirability of determining the relation between the chemical composition of hydrocarbon oils and their physical properties such as viscosity and oiliness. The dimensions of the lubrication problem, which has been successfully attacked, will be better understood when it is realised that excellent lubricants are produced for such widely separated cases as the airplane engine and the Diesel of a submarine. In the last case in particular efficient lubrication is vital, as the range of underwater boats is limited by the amount of lubricant for which carrying space can be spared, the consumption being particularly heavy in these cases. P. D.

672. Insulating Oils. C. O. Harvey. *J.S.C.I.* October 7.

The production of a low viscosity oil of low iodine value and high flash-point which does not deposit paraffins at temperatures well below the freezing-point of water and which contains a low percentage of matter volatile at 100° C., calls for the use of special crudes. In addition the oil must have exceptionally good insulating properties, be without action upon any part of the transformer, and must not undergo rapid chemical change when subjected to elevated temperature and electrical stresses in the presence of atmospheric oxygen. Low insulating power in an otherwise satisfactory oil is invariably due to the presence of moisture, quantities of the order of 0·005 per cent. being sufficient. The most important property of a good transformer oil is undoubtedly its capacity for resisting atmospheric oxidation and freedom from tendency to form sludge. Rodman states that three distinct types of sludge are found in

transformers, namely, asphaltic, soap and carbon sludge. The first consists largely of oxygenated bodies of high molecular weight and has good insulating properties, its detrimental action being due to its low heat conductivity. The second arises through the development of acidity in the oil, subsequent action upon the metallic parts of the transformer giving rise to salts of organic acids, which have poor insulating properties. The third, caused by "arcing" or "corona discharge," is less common. It has poor insulating properties but may be removed by filtration. Even the best oil is capable of undergoing oxidation, and atmospheric oxidation should therefore be eliminated from the transformer as far as possible by the use of some form of oil conservator. Other features which should be avoided are conditions giving rise to "silent discharge" and local overheating; contact with substances which will catalytically assist in the oxidation of the oil: the use of materials containing volatile hydrocarbons and of synthetic resin products containing excess of phenols or aldehydes.

In Dr. Michie's sludge test the oil is maintained at a temperature of 150° C. and air blown continuously for 45 hours, the sludge being weighed after the addition of petroleum ether and standing overnight. The test is tedious and difficult to carry out in view of the fact that the quantity of air and the temperature have to be carefully controlled. Further, Stäger points out that in tests of this nature no account is taken of acids and superoxides formed during the oxidation, which do not necessarily contribute towards the sludge value but which may nevertheless detract from the insulating properties of the oil. Kissling's tar test, on the other hand, takes account only of the acidic substances formed during oxidation. In the Brown Boveri test an attempt is made to determine sludge, developed acidity and superoxide development, and this appears to be the most thorough method of testing suggested up to the present. Stäger maintains that, contrary to general belief, acid formation precedes sludge formation, the unsaturated hydroxyacids formed giving rise to lactones and polymerisation of these causing deposition of sludge. He also regards the temperature in the Michie test as being too high, fatty acids of low molecular weight being formed by decomposition of the oil. Paraffin hydrocarbons are not likely to undergo such drastic changes under normal working conditions, though it is possible that, under the combined influences of oxidation and heat, "cracking" and dehydrogenation may occur, resulting in the formation of paraffins of lower molecular weight olefines, naphthenes, aromatics, etc. In the presence of metallic salts polymerisation of these compounds may occur, but a greater danger lies in the possibility of ozonide or peroxide formation, with subsequent formation of aldehydes, ketones and acids. Diolefinic substances may undergo similar changes to the olefins; naphthenes may be oxidised to naphthylenes, and these give rise to asphaltenes. Conjugation of double bonds may cause the formation of rubber-like substances in a manner analogous with the cyclo-octadienes. The effect of sulphur upon caoutchouc suggests that the presence of sulphur- and nitrogen-containing substances in the oil may assist polymerisation, this theory being indirectly supported by the fact that asphaltenes, obtained from natural asphalts, contain combined sulphur. Phenols, if formed during the oxidation of the oil, may combine with aldehydes arising from unsaturates, forming resinoid bodies.

This summary of reactions which may take place in the oil is not put forward as an exhaustive theory accounting for sludge formation. The changes occurring are undoubtedly very complex, but it is obvious that all classes of compounds other than naphthenes and paraffins are liable to give rise to objectionable products, and even these may undergo slow oxidation. Becker states that fatty and mineral oils, subjected to a silent discharge,

undergo molecular condensation with loss of hydrogen and an increase in viscosity. It is therefore possible that changes in the properties of an oil may occur in the absence of air. Van der Heyden and Typkee have found that the development of sludge and acidity may occur owing to the action of light, and care should therefore be exercised when storing samples of oil, or discrepancies in the analytical results may occur. S. W. C.

673. Results of Tests on Splitting "Dumps" in Treating Lubricating Oils. H. L. Kauffman. *The Refiner*. September, 1927.

The refining of petroleum distillates and residual oils with sulphuric acid is accomplished by mixing the acid with the oil, usually in several doses, by means of air or mechanical agitation. A sludge consisting largely of reaction products forms and is drawn off. Thereafter the oil is neutralised with a solution of caustic soda or other alkali; or the oil is neutralised merely by contact filtering the acid oil, the finely divided clay serving to decolourise as well as to deacidify the oil. The refining effect increases with the amount of acid added, but is not proportional to it. In fact, in the treatment of most lubricating oils there seems to be a limit beyond which it is no longer economically feasible to use additional amounts of acid. With some oils also use of too large a quantity of acid gives an objectionable fluorescence to the oil. With regard to the strength of acid used it has been found that the proportion of acid necessary to obtain a certain degree of refining effect rapidly increases as the strength of the acid diminishes and below a certain limiting concentration the specific action of the acid ceases. When it is desired to decolourise the oil as much as possible with sulphuric acid then it should be treated at the lowest temperature possible. But if the object of the treatment is to separate a maximum amount of unsaturated and bituminous compounds, then a hot treatment should be carried out. For mixing, air agitation is the usual method adopted. This has the objection that it tends to oxidise and darken the oil and, if prolonged, to cause the formation of organic acids which during the subsequent alkali treatment form compounds that give very troublesome emulsions. Light oils are frequently mixed with acid by means of a circulating pump. If the oil and acid are agitated for too short a period of time the refining of the oil will be incomplete and the acid sludge will not settle well. On the other hand, too long a period of agitation is detrimental as it increases the tendency of the oil to oxidise and because some of the coloured asphaltic substances resulting from the action of the acid on the oil again go into solution to a small extent. In general the higher-boiling the petroleum fraction being treated, the more rigorous is the treatment required in order to obtain a certain colour or degree of refinement. Further, the quantity of acid required for treating an oil of a particular viscosity decreases with the narrowness of the fraction. Now there follows the chief object of the article—the fractional addition of the acid. Generally a more efficient treatment of the oil is obtained with the same amount of acid, if the acid be applied to the oil in several portions (settling being allowed and the acid sludge drawn off after each individual treatment) than if the acid were all added at one time. An extract from Gurwitsch giving possible reasons for this phenomenon is included here. There follows the results of laboratory tests made in applying acid in various dosages or dumps to a lubricating oil. The oil used was a long residium of 425° F. flash resulting from the reduction of Salt Creek crude oil. It had a pour test of 110° F., and contained besides wax a good deal of asphaltic matter, the crude being of the mixed base type. A total of 45 lb. barrel of 66° Bé sulphuric acid was applied to the oil in 10 different treatments and all results carefully recorded. A total of 4000 c.c. of oil was taken for each treatment. The oil was both treated and settled at 140° F. The oil

was air-agitated for from 20 to 45 minutes or the shortest possible time necessary to have a clean separation of the resultant sludge.

The table of results shows that the percentage loss was least on the 8–27–10 treat where it was 25·28 per cent., and on the 45-lb. treat 26·72 per cent., and greatest on the 15–15–15 treat, where it was 30·83 per cent., and on the 22·5–22·5 treat 30·68 per cent. All oils were contact filtered to a 5·5 N.P.A. colour with finely divided decolourising materials. The 15–30 treat required the smallest quantity (1¼ lb./gallon) of "100-up" mesh fuller's earth. The 17–17–11 treat required the smallest quantity (3¼ lb./gallon) of a 200 mesh untreated Utah clay. The 22·5–22·5 treat required the smallest quantity (1¼ lb./gallon) of a 200 mesh treated Utah clay.

In addition to showing the way in which the acid would be fractionally added to this particular oil in order to remove the largest amount of asphaltic matter, these laboratory tests showed also that the decolourising effect of a given filtering material is dependent also upon the amount of free acid remaining in the oil as well as on the efficiency of the particular acid treatment. S. W. C.

674. RESULTS OF ACID TREATMENT OF FULLER'S EARTH. H. L. Kauffman. *Ref. and Nat. Gas. Manuf.*, 1927, VI., 10, 60–62.

The use of highly adsorptive, acid-treated clays for decolorising and deacidifying petroleum products has shown a marked increase during the last five years. The clays, usually of the bentonite type, when ground to a 200-mesh fineness and treated with from 40 to 50 per cent. by weight of sulphuric acid, followed by washing to remove excess acid and products of reaction, become from 4 to 10 times as efficient as finely ground fuller's earth for decolorising purposes, the original efficiency being only about one half that of fuller's earth. The enhanced efficacy is largely due to changes in the internal structure of the pores of the clay. The occurrence, mining and milling of fuller's earth are described. The material employed in the experiments was a Georgia fuller's earth, of the grade known as "100-up" mesh. It was mixed with 66° Bé sulphuric acid (50 per cent. by weight) and water added to give an acid concentration of 20 per cent., the whole being digested under a reflux condenser for 5 hours at 200° F. The pulp was then washed with four successive portions of water at 180° F., using one gallon of water per pound of earth in each washing. Comparative decolorising experiments with the treated and untreated fuller's earth showed that the former was only from 20 to 40 per cent. more efficient than the latter. H. G. S.

675. MERE WATER TREATMENT BENEFICIAL TO SOME DECOLOURISING CLAYS. *The Refiner*. November, 1927.

Some clays possess a noticeable and often an appreciable decolourising value in their raw state. In most cases, however, a special treatment of the clay is necessary in order to bring it to its maximum value as a decolourising agent. Upon examination under the ultra-microscope and in polarised light, it has been found that those clays possessing high adsorptive values have a very fine micro-structure. The particles themselves are honeycombed by innumerable microscopic channels that bring about an enormous increase in the adsorptive surface. In many of the naturally occurring clays and clay minerals these pores are clogged with various impurities consisting mostly of acid and water-soluble salts. Further, most clays possessing decolourising value are composed largely of crystalline silicates. Colloidal silica and silicates have a more porous structure than the same substance in crystalline form. Soaking the clay in warm water tends to convert the crystalline silicates in

certain clays to the colloidal or amorphous form, thereby greatly increasing the adsorptive power.

It has been found that heating oil and clay in the presence of superheated steam to a temperature very close to or at the point at which the oil begins to distil will also give a greater decolourising value for the clay than if the two are heated to say 250 or 300° F. Several examples are given. One clay, water-washed, and applied to the oil in the pulp form, the mixture being heated to 500° F. in presence of superheated steam, was found to be 141 per cent. more efficient than the same clay applied to the oil in a dry state and the mixture heated to 300° F. Other clays gave 458 per cent. and 204 per cent. increase in efficiency when used in this manner.

The water treatment is carried out by pulverising the clay and mixing it with an excess of warm water, the excess water being removed after mixing, leaving from 30 per cent. to 500 per cent. by weight of water to clay in the finished product. This procedure is repeated as many times as is necessary for the removal of impurities. The plastic mixture is then added to the oil to be treated and heat applied to the mixture to drive off water and bring about the decolourising action of the clay. This principle is covered by a patent (No. 1,533,060) issued to I. A. Clark on April 7, 1925, and assigned to Producers and Refiners Corporation, later being transferred to H. L Kauffman. S. W. C.

676. The Moisture Content of Oils Employed in Electro-technique. N. A. R. Mathis. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry, 1927.

A rapid method of estimating water content: the appearance of oil as a function of moisture content. Qualitative tests:—(1) Change in appearance on heating. (2) Hot iron method. (3) Copper sulphate method. (4) Method of "rigidity." Methods of dehydration:—(1) Filter press. (2) Centrifuging. (3) Heating. Quantitative tests:—(1) Heating and weighing before and after. (2) Weighing and distillation. (3) Distillation and measurement of volume. W. H. T.

677. The Stability of Transformer Oils. N. A. R. Matthis. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry. 1927.

The importance of the electro-technical point of view. Oxidation is the principal cause of the alteration of oils in service. It would appear from numerous researches that there is a relation between the resistance to oxidation and the extent of refining. The proposed stability test is capable of indicating over-refining as well as under-refining. The temperatures employed are the principal factors in this artificial ageing test. It is carried out under standard conditions regarding (*a*) surfaces exposed to air, (*b*) volume of oil in vessels of standard dimensions, (*c*) cleanliness of vessels with particular regard to solid matter or any material liable to have a catalytic effect on the oil. For stable and refined oils cracking will not take place at the temperatures used. Determinations of volatility and acidity after heating under the indicated conditions completed the tests. W. H. T.

678. Acids in Automobile Crank Cases. A. F. Meston. *Industrial and Engineering Chemistry.* February, 1927. 312.

The oil and vapours in an automobile crank case are always acid, but it is difficult to say how serious this condition may be. The work which has provided the observations given in this article was undertaken to supply additional information on the subject of crank case acidity, its extent and

distribution. The data were obtained from test runs on a Chalmers six engine and from experimental and routine runs of a number of better known cars. The oils used are advertised as "100 per cent. Pennsylvanian." Tests show that acidity increases steadily to a definite degree, after which an apparently stable state is reached, and dilution increases rapidly to an equilibrium value which depends upon mean temperature and humidity. In general the diluent distilled from crank case oil has a higher acidity than the oil from which it is taken.

A few determinations of sulphur were made, but although there was an increase in the total sulphur in the crank case the increase was small considering the amount which must have passed through the engine with the fuel. The advisability of good crank case ventilation for keeping down sulphur is mentioned.

General tests only were applied to identify the acids present in the crank case. Naptheneic acid is present in the used oil and its diluents and, to a less extent, in the water vapour removed from the crank case. Water from crank case vapours was found to be definitely corrosive to steel, and the presence of iron in the water layers from the crank case and in the used oil prove corrosion in the engine. E. R. B. S.

679. Results of Experiments in Use of Solvents for Dewaxing Paraffin Base Oils. Smith. *Oil Age*. October, 1927.

Previous work has shown acetone to be required in too great volume (80 parts to 1 of oil) to be commercially possible in the separation of wax from lubricating oil. As isopropyl alcohol can be made from the gases from petroleum cracking stills, it was tried as a solvent, but in its commercial form (91 per cent. alcohol 9 per cent. water) it offered no advantages over acetone. Dried over solid caustic soda and anhydrous copper sulphate it proved an excellent solvent. Secondary butyl alcohol also gave good results. Comparative figures obtained were :—

	% Oil.	% Wax.	% Loss.
Acetone	74·1	18·1	7·8
Dehydrated isopropyl alcohol ..	68·1	21·4	11·5
Secondrary butyl alcohol ..	82·4	8·3	9·3

As the dehydration of isopropyl alcohol proved troublesome, further experiments were made with secondary butyl alcohol. Using mixtures of oil 1 : 1, 1 : 2 and 1 : 3 (oil to alcohol) and centrifuging at 3000 r.p.m. for 5 minutes at 0° C. good separation was obtained in the two latter cases. Filter pressing was not successful because of the smallness of the crystals, but cold settling proved successful. The solvent may be used in admixture with acetone.
A. R. S.

680. Fundamentals of Correct Lubrication. A. J. Turner. *Oil and Gas J*. September 29, 1927.

Eight factors must be analysed in the determination of the correct lubricant. These are—speed, pressures, clearances, temperatures, distribution, material and finish of rubbing surfaces, whether moist or dry rubbing surfaces, whether lubricant is to be used internally or externally. Small clearances require light bodied, quick-acting oils, while larger clearances require heavy bodied oils to maintain an unbroken film between the surfaces. The lightest bodied oil that will maintain a lubricating film under the various operating pressures is the most efficient oil to use owing to the fact that frictional losses are reduced to a minimum. A. R. S.

681. Resolving Emulsions. E. E. Ayres. Assr. to Sharples Speciality Co. U.S.P. 1,646,339. October 18, 1927.

Water-in-oil emulsions such as are obtained when washing acid treated petroleum oils are resolved by adding to the emulsion an organic reagent which does not contain a metal, and which will provide an emulsifying colloid soluble in or wetted by the water to counteract the stabilising influence of the emulsifying colloid soluble in or wetted by the oil. Examples of suitable substances are glue, gelatine, albumin, casein, gum arabic and gum tragacanth.

A preferred process consists in adding to the emulsion sufficient gelatine to coalesce the water dispersed in the oil and subjecting the product to subsidence. H. S. G.

682. Process of Refining Mineral Oils. T. Hellthaler. U.S.P. 1,643,272, 1927. Application, August 1, 1925.

Titanium tetrahalides, diluted by inert substances, are used in refining oils. The inert substances may be solid, such as fuller's earth, kieselguhr, soda ash, etc., or liquid, such as chlorinated hydrocarbons, petroleum ether, benzine and the like. The treatment, which is carried out at room temperature, is followed by agitation with a basic earth capable of absorbing the acid formed and bleaching the oil. An example quotes the employment of a mixture of 2 per cent. of titanium tetrachloride and 2 per cent. of fuller's earth. H. G. S.

683. Reducing Auto-oxidation of Oils and Fats. A. Rechburg, G. Braun and H. Ostermann. E.P. 254,303. June 21, 1926. Conv. June 24, 1925.

Auto-oxidation of oils and fats used for greasing wool is prevented or materially reduced by the addition to the oils and fats of substances, such as sulphur or arsenic sulphide, which are known catalyst poisons, the natural properties of the wool not being impaired thereby. H. S. G.

684. Improvements in or relating to the Purification of Waste Lubricating Oils. E.P. 278,434. October 6th, 1927. Street and Hey.

The used oil is diluted with 20–50 per cent. of petroleum spirit and centrifuged, removing the water and finely divided impurities. The residue is then treated with concentrated sulphuric acid and then neutralised with soda. A decolourising agent is then added and subsequently removed, after which the diluent is distilled off. A. R. S.

685. Method of Treating Hydrocarbons. A. B. Way, Assr. to L. A. Way. U.S.P. 1,638,021. August 9, 1927.

The method is used to demulsify heavy oils such as cylinder and furnace oils and consists in the addition of a mixture such as 95 per cent. naphthalene, 4·5 per cent. nitrobenzene and 0·5 per cent alizarin and subjecting the mass to a temperature not exceeding 200° F. A. R. S.

See also Abstracts Nos. 643, 648, 687 and 699.

Special Products.

686. Recovery of By-Products from Acid Sludge. G. W. Cupit. *The Refiner*. September, 1927.

The acid sludge to which reference is principally made is that obtained by acid treatment of reduced paraffin base crudes. From a thorough examination of the crudes and the assay distillation thereon one can predict

with marked accuracy the nature of the sludge produced on acid-treating the reduced crude. The nature of the base, however, is the governing factor. With crudes possessing both asphaltic and paraffin base properties it is not so easy to predict the exact nature of the acid sludge. In the majority of cases acid sludge from a paraffin base crude will not treat up well by the same method as that used for one from an asphaltic base crude.

The treatment is carried out in a cokeing kettle. Gas oil of 24—28° Bé is charged into the kettle to the extent of ¼ volume of acid sludge to be treated. An equal volume of water is added and the contents raised to 190° F. with open steam. The acid sludge is run in from the agitator and allowed to steam for 6—8 hrs. At the end of this time there will be three layers—acid oil or tar on the top, acid coke in the middle and spent acid on the bottom. The contents are left to settle in this condition for 14—16 hrs. After complete separation the acid oil and spent acid are each pumped to storage tanks. The amount of acid sludge treated at one time is 720 barrels.

To the acid coke remaining in the kettle 300 barrels of hot water are added and again steamed for 4—5 hrs. and allowed to settle for 2—3 hrs. The spent acid is again pumped to weak acid storage tanks. To the acid coke is added 100 barrels of spent soda ash solution (from a previous treat) and the contents steamed for 1 hr. After 1 hr.'s cooking and 1 hr.'s settling the salt-acid solution is drawn off to the sewer. Then 120 barrels of 33° gravity soda are added to the acid coke and live steam turned on for 1 hr. To reduce the viscosity of the contents, the acid oil pumped off the top on the first separation is pumped back to the kettle and the contents steamed 1 hr. longer. 200 barrels of water are then added and the contents steamed 6—8 hrs. and allowed to settle 8—10 hrs. The kettle then contains asphalt stock on top and spent soda solution at the bottom. The latter is pumped to storage tanks and retained for another treatment.

The asphalt stock is now charged to a still and the fires started at full capacity until the temperature has reached 195° F. At this point the fires are checked until all the moisture is off and then put on full blast again until the temperature reaches 350° F. At this temperature bottom steam is started in the still and the temperature raised 25° per hr. till 425° F. has been reached. A sample of the charge should be taken and tested for melting-point, 100° being the desired m.p. When this is reached bottom steam is shut off and enough top steam put on to kill existing gases. The safety valve is raised and the asphalt pumped through a cooler to reduce it to 500° F. or lower into an oxidiser. The type of oxidiser that has given the most satisfactory results is that known as the vertical beehive type. After the oxidiser is charged the temperature of the contents should be 450—475° F. Top steam is added gradually and increased to full valve by the time the temperature has been raised to 520° F. Here the fires are checked and air induced through the spider till the temperature has been raised to 550—560° F. It should be kept at this point and hourly samples tested for melting-point. Tests on various melting-point products made by this process from acid sludge are tabulated. They show a high melting-point low evaporation; low sulphur content; good flash and fire-points; and a high percentage solubility in CS_2 and CCl_4.

Another asphalt product made from acid sludge which has found its way into the asphalt and paint businesses is made from acid oil. The acid oil is pumped direct from the kettle into the still and fired full blast till the temperature reaches 450° F. At this temperature four or five spokes of top steam are added and a half-valve of air induced through the steam coil gradually till a full valve has been added. The fires are checked at 500° F. and the temperature raised by air oxidation to 530—550° F. and kept there.

When the temperature has reached 530° F. samples are taken and tested every 2 hrs. for melting-point. When the m.p. has reached 210° F. air is cut off and top steam induced. The product thus obtained is smooth, glossy and brittle.

The recovery of various acid sludges from acid-treating distillates is followed out in the same manner. The best results are obtained by mixing sludges obtained from both paraffin and asphaltic base-oil distillates, the proportions depending upon the product desired.

The sludge is treated in a kettle exactly as before, the acid oil and spent acid layers being pumped to storage. The processing of the acid coke is, however, quite different. By the aid of a screw-conveyer and water, the acid coke, as it drops from the sludge kettle into a trough by gravity, is crushed into a somewhat granular paste and conveyed to a ground tank, from which it is pumped to a second kettle. After 45 mins.' settling in this kettle the water is pumped off the top. Then 100 barrels of 33° gravity soda ash solution are added and the contents blown with air for approximately 3 hrs. At this point an average sample is tested for alkalinity and if slightly alkaline, 400 barrels of gas oil are added and the contents again blown with air for 3 hrs. After steaming 3 hrs., the contents are blown 45 mins. longer, followed by 3—4 hrs.' steaming. The contents are now tested for alkalinity. If additional soda-ash is required it will be necessary to resteam for 3 hrs. When a slight excess of soda ash is indicated 200 barrels of hot water are added and the contents steamed for 20 hrs. The treat is finished by adding 500—600 barrels of hot water and steaming for 1 hr. Settle for 5 hrs. Spent soda is then drawn off and asphalt stock pumped to storage tank for further reduction. If asphalt products are not desired this stock can be used as fuel oil.

The asphalt stock is charged to a still and fired till 450° F. has been reached, when top steam is admitted and air added through the bottom coils. When 500° F. is reached the fires are checked and the air allowed to oxidise the contents till a temperature of 550° F. has been reached. Samples for melting-point are taken every half-hour and when within 2/5° of the desired point, the air is cut off and top steam increased. The contents are then pumped to storage.

Asphalt products having melting-points of 120—150° F. have been made on a plant scale with marked success, but products having higher melting-points have not given very good results. The reason, no doubt, is due to a too vigorous oxidising effect upon the by-product. S. W. C.

687. Effect of Moisture on Electrical Properties of Insulating Waxes, Resins and Bitumens. James A. Lee and Homer H. Lowry. *Ind. & Eng. Chem.*, Feb., 1927, 302.

This article is a summary of the results obtained by careful experiments on the change in electrical properties of insulating waxes, resins and bitumens after being subjected to six months' exposure to a solution of sodium chloride. Thirty-one materials were subjected to the tests and these include naturally occurring substances and commercial products and mixtures. Four samples of each material were prepared in the form of discs 3·5 ins. in diam., and 50 mils thick. The samples were first dried to constant or minimum weight in a desiccator over calcium chloride and subjected to electrical tests for dielectric constant, effective A.C. conductivity and volume resistivity.

They were then immersed in a 3·5 per cent. aqueous solution of sodium chloride solution, which is equivalent to exposure to 98 per cent. humidity, and stored in a room at about 24° C. They were then removed at intervals and the surface carefully dried before being weighed to obtain moisture

content and retested electrically, after which they were replaced in the solution.

Although most of the substances were still slowly changing in moisture content and electrical properties, they were removed from the solution after six months, electrically tested, dried to constant or minimum weight over calcium chloride and again electrically tested.

Brief particulars are given of each material tested and the method by which the samples were prepared. Tables are given showing the electrical properties of each sample initially, after immersion and after redrying, and also a table of final water content and difference between initial and final weights.

Results show that, with the exception of bayberry and spermaceti wax and shellac, the naturally occurring waxes, resins and bitumens show fairly small changes in dielectric constant on immersion, the change varying with the amount of moisture absorbed. The three exceptions all absorb relatively very large amounts of water. Stearic acid and the stearates absorb relatively large amounts of water and also increase in dielectric constant more than most natural waxes.

The effective A.C. conductivity covers a wider range of values than does the dielectric constant, but in general there is a good relation between high dielectric constant and high A.C. conductivity and a direct comparison may be made.

Changes in resistivity of the materials parallel those in dielectric constant and conductivity.

Attention is drawn to the considerable amount of water absorbed by some of the waxes, shellac absorbing from 4·3 to 5·1 per cent. of water under the conditions of the experiment and losing its insulating properties to a greater extent than any of the other naturally occurring waxes, resins or bitumens tested. E. R. B. S.

688. Sealing Material for Gasometers. Robert Mezger. U.S.P. 1,641,089, Aug. 20, 1927.

This patent covers a new product for sealing the gap between a dry gasometer casing and the disc movable therein. The sealing medium generally used in this type of gasometer is high-temperature coal-tar and the distillation products obtained therefrom. High-temperature coal-tar is liable to rapid thickening, partly by polymerisation and partly by loss of its lighter constituents into the gas stored. Also water precipitated from the gas may form an emulsion with the tar.

The new sealing material suffers from none of these disadvantages and in addition forms a protection against corrosion to the parts over which it flows.

The patented product consists of a solution of mineral bitumen or pitch, in a mineral oil or oil consisting mainly of paraffins. The mineral oil used as a solvent has an initial boiling-point of about 300° C. and a freezing-point not above —20° C., while its flash-point is not below 150° C.

A typical sealing medium would consist of twenty parts of mineral oil pitch in eighty parts of mineral oil having a specific gravity of 0·915, a flash-point of 150° C., and a freezing-point of below —22° C. The oil, when subjected to fractional distillation, yielding 70·3 per cent. of distillate between the temperatures of 300° C. and 360° C. E. R. B. S.

689. Preparation of Saturants. J. Zavertnik, Jun. U.S.P. 1,636,271, 1927. Appl., Jan. 7, 1924.

Asphalt saturant, *e.g.*, for water-proofing purposes, is heated to 425°—475° F. by passage through heated coils, is oxidised by means of a current

of air in a tank and is then pumped into a second tank in which the proofing takes place. During the latter operation the saturant is maintained at the correct temperature by means of a stream of oil which is heated in the furnace used for heating the asphalt. H. G. S.

See also Abstract No. 705.

Analysis and Testing.

690. Waters Method for Determining Sulphur in Petroleum Products. Catlin. *Refiner*, Oct., 1927.

The petroleum product is treated in a closed crucible with concentrated nitric acid saturated with bromine, by digesting from two to three hours on a steam bath. Following this digestion the remaining acid is neutralised with anhydrous sodium carbonate—the excess used depending on the nature of the sample. The crucible is now carefully dried and ignited until all the organic matter is removed, stirring with a glass rod during the operation. If the material seems too dry and slow in ignition it may be speeded up by the addition of potassium nitrate crystals or concentrated nitric acid. The crucible is now treated with distilled water and hydrochloric acid to dissolve the contents, and then the sulphur precipitated as $BaSO_4$. It is suggested that this precipitate may be brought down using specially graded barium chloride or oxalate and the amount measured in the Parr sulphur photometer.

Among the advantages claimed for the method are that only ordinary laboratory apparatus is required, the amount of the sample can be widely varied according to sulphur content and many samples can be done at once. The disadvantages are the time of preparation and ignition of the sample.

The method gives equal accuracy to the bomb method, but is not suited to volatile oils. A. R. S.

691. Quantitative Determination of Sulphur and Sulphur Derivatives of Hydrocarbons in Naphtha Solutions and in Petroleum Distillates. W. F. Faragher, J. C. Morrell, and G. S. Monroe. *Ind. Eng. Chem.*, 1927, **19**, 1281—1284.

A procedure is described for the quantitative determination of sulphur present in naphtha as hydrogen sulphide, elementary sulphur, mercaptans, sulphides, disulphides and, by difference, residual sulphur (thiophenes).

Hydrogen sulphide.—Hydrogen sulphide, which interferes with the determination of the elementary sulphur and the mercaptans, must be first eliminated. This is done by shaking the sample for 2–3 minutes with a sufficient quantity of weakly acid cadmium chloride solution for complete precipitation. The acidity of the solution should be approximately 0·32 per cent., this concentration having been found sufficient to prevent the formation of cadmium mercaptides without hindering the quantitative precipitation of hydrogen sulphide.

Elementary Sulphur.—This is next determined by shaking the sample with metallic mercury. A lamp determination of the sulphur content before and after the mercury treatment gives the elementary sulphur by difference. Oxidation of the precipitated mercuric sulphide according to the method of Ormandy and Craven is considered by the present authors to be tedious.

Mercaptans.—The mercaptans may be determined by one of two methods: (*a*) A sample of the oil, after removal of hydrogen sulphide and free sulphur, is dissolved in benzene and shaken with alcoholic sodium plumbite. The lead mercaptides formed dissolve in the alcohol and a lamp determination upon the washed and filtered oil gives the sulphur, in the form of mercaptans, by difference; (*b*) An aliquot portion of the oil freed from hydrogen sulphide and sulphur is dissolved in benzene in a separating funnel. From 40–50 c.c. of

basic lead acetate suspension are added and the whole well shaken. The mercaptans present react readily with the basic lead acetate to form lead mercaptides which dissolve in the benzene. The aqueous layer is removed and the oil layer filtered into another separating funnel. A known quantity of 0·1 N. Sulphuric acid is added and the funnel shaken until the greenish yellow colour of the mercaptide disappears. The aqueous layer is filtered to remove lead sulphate and the filtrate, as well as the combined washings, titrated with $\frac{N}{10}$ caustic soda. The percentage of mercaptan sulphur is calculated from the acid used.

The use of iodine for the determination of mercaptans can be adapted to the lead mercaptides, but it is obvious that it cannot be applied to cracked distillates on account of the olefines present.

Disulphides.—The sulphur in the form of disulphides is determined in an aliquot portion of the oil free from hydrogen sulphide and elementary sulphur by refluxing it with dilute sulphuric acid and zinc dust, and then removing the mercaptans formed by means of alcoholic sodium plumbite as in Method (*a*) described above. A lamp determination then gives the sulphur remaining in the oil as sulphides and thiophenes. The use of the titration method at this stage gives inexplicable results which must be multiplied by the factor $\frac{2}{3}$ to give the correct result. It is therefore advisable to use the extraction rather than the titration method.

Sulphides.—Sulphur in this form is determined by treating the oil from the disulphide estimation with mercurous nitrate. This substance has been found to precipitate the sulphides almost quantitatively, so that a lamp determination of the thiopene sulphur gives the sulphide sulphur by difference.

Analyses of naphtha solutions containing known amounts of elementary sulphur, mercaptans, sulphides, disulphides and thiopene and saturated with hydrogen sulphide were found to be in close agreement with the quantities actually known to be present.

Analyses of distillates prepared from three different crudes are also given.

S. F. B.

602. Detection of Sulphur in Petroleum. Lane and Devine. *Oil and Gas J.*, Oct. 20, 1927.

It is claimed that the method as given below will detect sulphur when present only to the extent of ·02 per cent.

A quarter-inch cube of sodium is melted in a pyrex test tube clamped in a vertical position until one-half inch of sodium vapour is present above the metal. Five drops of the oil are then directly dropped on to the sodium and the tube then heated to dull redness. The tube and contents are then crushed with water (about 10cc.s.) and filtered into a narrow necked test tube. The solution is acidified with hydrochloric acid and boiled under a piece of lead acetate paper. A brown stain indicates sulphur. A. R. S.

603. A Volumetric Method for the Determination of the Ash Content and Calorific Value of Coal. Lategan. *Fuel*, Oct., 1927.

The real specific gravity of clean coal varies between 1·25 and 1·35 approximately. The specific gravities of the impurities which form the greater part of the ash average 2·6.

Thus, in general, the relation between density of coal and impurities may be taken as 1 to 2, although the actual value of the relationship will naturally vary for different seams. A definite relationship does exist for each seam.

In the finely-divided state the volume occupied by a given quantity of coal and its impurities is inversely proportional to its density which as previously

shown, is a linear function of the ash content of the mixture. If specific volumes of coals of varying ash content are plotted against ash percentages the points will fall on a straight line.

The Taffanel Voluménomètre is a specific gravity flask with a graduated detachable stem ground into the top of the flask. The total volume of the flask measures 57 cc.s. to the 100 mark on the bottom of the stem and 62 cc.s. to the zero mark.

15 gms. of 30 mesh air dried coal are brushed into the flask and shaken with 25 cc.s. alcohol till thoroughly wetted, when a further 25 cc.s. is added. The volume of the alcohol to the bottom of the meniscus is now read and the ash content obtained from the graph. Results do not differ by more than 1 per cent. from those obtained by incineration.

Relationship between cal. value and ash content :—

Since generally coals from similar sources have the combustible matter of the same composition, therefore the calorific value of this coal substance should be constant and equivalent to the cal. value of the wet coal divided by 1 minus the sum of the ash and moisture. In practice, however, due to the fact that the ash as weighed is not the ash as truly present—since shale loses its water, pyrites is oxidised to ferric oxide, etc.—this value deviates from the value by direct experiment the more as the ash increases.

Assuming that coals deposited under similar conditions contain incombustibles of similar nature and composition, the percentage loss on incineration will be the same and therefore the cal. value will be a linear function of the ash percentage as weighed. Since the cal. value of dry coal is equivalent to that of the pure coal substance multiplied by 1 minus the ash as weighed, it follows that the cal. value of the dry coal must be a linear function of the ash per cent. Experiment has given the following relationship :

$$E = \frac{15{,}600}{84}(84—A).$$

$$\text{or } E = 186\ (84—A)$$

when E = cal. value in B.Th.U. 1 lb. (dry basis),
and A = ash per cent. (as weighed).

Results of this determination on Witbank district coal gave a variation of within ½ per cent. from that by direct estimation. A. R. S.

694. Apparatus for Fractional Distillation under Reduced Pressure. Morrell and Egloff. *Ind. and Eng. Chem.*, Nov., 1927.

The two distillate receivers, which are of cylindrical shape and graduated are connected to the condenser at the top by means of a three-way mercury sealed stopcock. At the bottom of each is a draw-off cock, and near the top are the vacuum lines separately connected by three way cocks to a large pressure stabilising bottle.

The operation is the normal method. A. R. S.

695. The Analysis of Mixtures of Fuels by the Dispersion of Refraction. M. R. Moutte. The Identification of Fuels by Rotary Magnetic Polarisation. M. Javel. The Ultra-Violet Absorption Spectra of Fuels. M. A. Andant. The Measurement of Electrical Inductance Properties of Fuels. M. R. Toussant. *Bulletin de la Société de Chemie Industrielle. Seventh Congress of Industrial Chemistry*, 1927.

These diverse studies refer to the systematic research carried out by the Service Technique et Industriel de l'Aéronautique in order to extend and perfect the physico-chemical methods of analysis and identification applied to fuels. W. H. T.

696. Measurement of Colour in Stammer Units on a Kober-Klett Colorimeter. Ritchie. *Ind. and Eng. Chem.*, Nov., 1927.

Ferric chloride solutions of various dilutions are compared with caramel solutions (sugar liquors) of known values in a Duboscq type colorimeter. It is thus found possible to find the Stammer depth constant for ferric chloride using this colorimeter. A. R. S.

697. An Apparatus for Potentiometric Titrations. J. F. Spencer. *Chem. and Ind.*, **46**, 44.

In this apparatus the E.M.F. which is opposed to that between the electrodes is measured continuously on a voltmeter. In performing a titration the potentiometer is adjusted so that there is no reading on the galvanometer (*i.e.*, the E.M.F. between the electrodes is correctly balanced), and the voltmeter is read. More reagent is added and a second reading is taken, the results being finally plotted as E.M.F. against quantity of reagent added.

The standard apparatus described consists of a wooden base carrying the rheostat (54in., 20 S.W.G. Eureka), battery switch, tapping key and a reversing switch used for convenience to reverse the direction of the E.M.F. to be measured. A pillar holds the burette and a potassium chloride reservoir. The contents of the beaker may be heated by a bunsen and a motor and stirrer are provided.

The voltmeter and galvanometer are not fixed to the base.

The calomel electrode employed is 1/10th in. normal. For titrating acids and bases a hydrogen electrode is employed. This together with the hydrogen generator is fully described. P. D.

698. Colorimeter for Precise Matching of Solutions in Nessler Tubes. Yoe. *Ind. and Eng. Chem.*, Oct., 1927.

The colorimeter is similar to the Kennicot-Campbell-Hurley instrument, and consists of a wooden box with two apertures into which the cylinders fit and an observation tube at right angles to the Nessler cylinders. Above the cylinders are two mirrors, the one further removed from the eyepiece being broader, so that light reflected through the cylinders is again reflected through the eyepiece, each cylinder being responsible for half of the field. An approximate match is first made by looking down the open tubes and the final matching is done in the instrument. A. R. S.

699. Apparatus for Determining the Viscosity of Fluids. Albersheim and Konheim. E.P. 263,781. Oct. 20, 1927.

Since the viscosity of an oil is proportional to its internal friction, therefore if the oil be constrained to move with definite velocity the pressure will decrease with decreasing viscosity.

This principle is applied in a continuous viscosity tester by having a vessel containing the test liquid connected to a turbine wheel governed to rotate at constant speed. Oil under pressure passes over this wheel and by reason of the governer has imparted to it a constant velocity. From here it passes to a constriction in the pipeline before which there is placed a manometer or other pressure recorder. The reading of this gauge gives an indication whether the oil is retaining its viscosity.

The oil may be pumped back into service from the farther side of the pressure gauge. A. R. S.

700. Improvements in, or Relating to, Colour-Estimating Apparatus. The Tintometer, Ltd. E.P. 277,166, Sept. 15, 1927.

A sighting tube of the ordinary type blackened on the inside and fitted at its upper extremity with a single eyepiece is placed vertically on a stand and supported by two rods above another stand in the same plane. In the upper stand and placed symmetrically about the axis of the tube are two similar holes under which, by the rotation of an eccentric circular disc, two series of circular holes, one containing standard colour glasses, while the other is vacant, can be viewed. On the lower stand is placed a standard white screen illuminated by a standard source, there being a recess in the screen directly below the vacant series of holes in which the sample is placed. A. R. S.

See also Abstracts Nos. 657, 667, 668, 670, 676, 677, 714 and 727.

Refinery Plant.

701. Emery Plant Successful with Tube Still Distillation on Pennsylvania Crude. G. Reid. *The Refiner*, Oct. 1927.

The system of distillation employed is the design of Alexander Lackman. The larger units consist of a shell still, 52 ft. long, 16 ft. diameter, well insulated and having a capacity of 2,000 barrels. The shell still is directly connected to a tube still, through which the oil is circulated from the shell still and returned to it. The shell still is charged with crude, fires started under the tube still, and the circulating pump started. The pump takes suction from the shell still and discharges into the tube banks in the tube still, rising upward from the bottom tube bank in the cooler zone to the uppermost tube bank in the zone of highest heat, to be conducted back into the shell still. Oil entering the shell still is released into the large body of oil through a horizontal line at the bottom of the shell, in the bottom of which line there is a great number of very small perforations. That portion vapourized during circulation in the tubes rises through the oil, being scrubbed slightly as it ascends, and these vapours are conducted from the shell still through vapour lines to bubble towers, and thence to condensers. The oil is circulated in the tube banks at the rate of 700 gallons per minute. In this manner all of the gasoline, naphtha, and kerosene is distilled. Some steam may be used in the shell still, but no fire. The maximum temperature employed is about 470° F. for removing 46 per cent. to 48 per cent. of the crude. Both smaller and larger units are double, consisting of 2 shell and 2 pipe stills, which are operated alternately and batch. The larger units handle about 1,800 barrels of crude each 48 hour run. The original twin installation displaced 6 shell stills and increased the monthly crude runs from about 34,000 to 48,000 barrels. The time required to run down a given volume of crude was reduced about 50 per cent. This equipment has brought about the elimination of re-running and the yield of gasoline has been materially increased, with only one heating. When the charge of oil is entirely stripped of its gasoline, naphtha, and kerosene, the still is permitted to cool and the bottoms are transferred to a battery of shell stills. The subsequent distillation of this oil yields the gas oil, wax distillate, and cylinder stocks, which procedure is carried out in the usual manner. S. W. C.

702. New Type of Fractional Condensing Column. *The Refiner*, Nov., 1927.

In its construction the Leach fracto-condenser consists of an outer shell of cast-iron or steel plate, of circular section, 10 ft. in height and 5 ft. in diameter. Within this shell are a number of tubes calculated to balance

velocity of flow and possibility of fouling. These tubes extend vertically from a heavy base or channel casting and are expanded into floating heads at the top. The cooling medium or media passes through these tubes, the vapour condensing upon their outer surface. The channel casting contains a tube sheet into which the tubes are rolled and its top has integral basins formed upon it in which the distillate fractions collect and from which they are drawn through bleeder pipes. The tubes extend through the casting and communicate with the compartments at the bottom from which the cooling media are controlled. On the lower flange of the channel casting are a series of covers, used to control the path of the cooling medium. Rearrangement of these openings makes it possible to provide for the use of several combinations of cooling effects without danger of contamination through intermingling. The fractional control of the cooling media accomplished in this manner aids in condensing the vapours into the fractions desired. These fractions are then drawn off from a series of bleeder pipes extending from the condensate basins. Within the condenser shell, between the blocks of tubes, are several vertical baffles to direct the flow of the vapour and to create several compartments for the fractional condensation of the distillates in the vapour. The feed stock may be used as a cooling medium, thus enabling the recovery of a large amount of process heat. The column is not designed to eliminate or supplant a bubble tower, but merely to reduce the work required from a bubble tower and to permit the use of a fewer number of trays. S. W. C.

703. Mechanical Details of Certain Types of Fractionating Columns. Reid. *Refiner*, Oct., 1927, 74.

A general discussion of some of the principal types of fractionating towers now in use in refineries. Bubble cap towers of various designs are described and are contrasted with the older methods involving recycling. R. P. L.

704. Progressive Condenser. C. F. Braun. U.S.P. 1,640,748, Aug. 30, 1927.

The apparatus consists of a cylindrical shell, a tube nest extending longitudinally therein, connections at the ends of the shell for passing vapours through the shell along and around the tubes therein, connections at opposite ends of the tube nest for passing a cooling medium through and a number of substantially horizontally extending dephlegmating pans dividing the tubes into relatively small groups. The vapours pass longitudinally around and over the cooling and dephlegmating surfaces, which are of approximately equal area. A. R. S.

705. Art of Obtaining Products from Sludge. L. Burgess, Assr. to Standard Development Company. U.S.P. 1,642,060, Sept. 13, 1927.

The sludge is agitated at 120° F. with saturated brine, whence it passes to a separator. From here the process may be repeated or the separated sludge may be passed to a second agitator for neutralisation with slaked lime or soda ash. A. R. S.

706. Continuous Distillation of Hydrocarbon Oils. J. R. Carringer, Assr. to Standard Development Co., Delaware. U.S P. 1,644,324, Oct. 4, 1927. Appl. May 6, 1921.

Claims are made for a plurality of stills arranged in series in a battery of continuous stills, a fractional condenser connected to each still, a plurality of condensers, means for conducting vapours from the fractional condensers

thereto, a common vapour pressure equalising chamber, means for establishing communication between the vapour spaces of the fractional condensers of the stills and the pressure equalising chamber, means for introducing oil into the first of said stills, and means for connecting the successive stills to permit flow of oil therebetween. H. S. G.

707. Oil-Distilling Apparatus and method. E. C. D'Yarmett, Assr. to O. K. Herndon. U.S.P. 1,646,448, Oct. 25, 1927.

An apparatus whereby the oil-distillation process described in U.S.P. 1,646,449, Oct. 25, 1927, may be carried out, comprising a distillation chamber having an outlet for vapour generated therein together with means for heating and supplying oil to be treated thereto, means for conducting unvapourised oil from the chamber, means for separating the liquid and gaseous parts of vapour generated in the distilling chamber comprising a casing connected thereto and positioned therein a series of alternately arranged downwardly and upwardly extending baffles, compelling the vapour passing through to travel in a tortuous path, having upwardly and downwardly extending branches, the upwardly extending branches being of greater area than the downwardly extending ones and inclined forwardly with the downward ones rearwardly whereby to provide an elongated path.

With such an apparatus the elimination of entrained liquid from the vapours given off at various stages is insured, and the oil in the still is heated in such a way that any vapours given off will entrain a minimum amount, if any, of the liquid. H. S. G.

708. Oil Distillation Process. E. C. D'Yarmett, Assr. to O. K. Herndon. U.S.P. 1,646,449, Oct. 25, 1927.

A method for carrying out an oil distillation process in an apparatus, the dephlegmator, construction and advantages of which are described in the co-patent U.S.P. 1,646,448.

The oil is heated in a still apparatus which includes any suitable liquid-containing means, such as a plurality of chambers arranged in association with a suitable heating means, or a single furnace, the oil being adapted to pass from one compartment to another, and being raised in each compartment to a predetermined temperature.

The vapours are taken off from each compartment or chamber, and directed through a dephlegmator in which the vapours and any liquid follow a tortuous path by passing through a series of baffles alternately arranged upwardly and downwardly so that the velocity is greater when moving downwardly than upwardly. The baffles are arranged in pairs with narrower spaces forming the downwardly directed portions. The rapid downward and slow upward movement cause any entrained liquid or unvaporised oil to be thrown out, and when the vapours leave the dephlegmator for the condenser they contain no entrained oil or liquid of any kind.

Within the still container suitable means, such as baffles, are arranged in such a position that the oil travels not only from one compartment to the other, but also has a movement or cycle circulation at an angle to the longitudinal travel, and in which it circulates upwardly over a heated zone and downwardly through that portion of the still less exposed to heat. This prevents the generation of large quantities of steam, should any water be carried into the still with the oil, and small quantities of steam generated will pass from the still without entraining substantial quantities of oil, if any. H. S. G.

709. Art of Distilling Oils. Howard and Loomis, Assrs. to Standard Development Co., of Delaware. U.S.P. 1,640,938. Aug. 30, 1927.

Crude oil is continuously distilled by passing it successively through a series of stills whereby the lower boiling portions are removed. The residues are then forced continuously through a conversion system wherein they are brought to a conversion temperature at which they are maintained until substantial conversion has taken place, while maintaining sufficient pressure in the conversion system to keep the oil in the liquid state. On reduction of the pressure the products are distributed among stills containing crude oil being distilled. Thus separation of the products of conversion take place simultaneously with distillation of crude. A. R. S.

710. Apparatus for Treating Oil. G. C. Kelley. U.S.P. 1,465,398. Aug. 21, 1923. Reissue No. 16,778. Oct. 25, 1927.

A process and apparatus for treating oils to facilitate the separation of undesirable concomitants or emulsions. The oil drawn from a storage tank is directed into a heating apparatus in such a manner that a column of oil of relatively small transverse area and of indeterminate length is first exposed to gradually increasing temperatures and is then confined in tubes of relatively small diameter in which the maximum application of heat to the oil is effected. The result of the treatment is the avoidance of any sharply defined temperature difference in the column of oil and the assurance that it will flow through the passages in an uninterrupted stream.

The apparatus comprises a furnace, a hot water drum arranged horizontally in the furnace, a horizontally arranged passage for the oil of continuously restricted cross sectional area so as to avoid free spaces and a consequent turbulent condition in the oil. A portion of the passage is located in a flue for the combustion of the gases from the furnace and serves to preheat said oil, the rest of the passage being located in the drum and being of smaller cross sectional area than in the first part. A feeder pipe leads to this passage located so as to be exposed to the heat of the furnace gases and at a level sufficient to maintain a pressure head on the oil. The passage extends from the feeder pipe to the delivery end of the apparatus, the drum being adapted to contain a heated liquid medium for heating the oil while it is confined within the restricted passage to impart a maximum heat treatment, at the same time no substantial expansion, foaming or ebullition of the oil throughout the entire apparatus taking place. H. S. G.

711. Fractional Distillation. N. E. Loomis and W. K. Lewis, Assrs. to Standard Development Co., Delaware. U.S.P. 1,646,619. Oct. 25, 1927.

An improvement in the art of distilling petroleum oils having a large number of constituents of different boiling points to produce simultaneously and continuously a relatively narrow range boiling point product and a residual product substantially free from the lighter fraction. The process comprises distilling the oil and passing the vapours through a functionating zone or a plurality of series-connected zones, preheating at least a portion of the feed oil by indirect heat exchange with vapours from the fractionating zones, thereby partially condensing such vapours, introducing the preheated feed oil into an intermediate portion of the fractionating zone, flowing the oil downwardly therethrough in contact with ascending vapours, regulating the amount of condensation by by-passing to the fractionating zone any portion of the feed oil in excess of that required in the heat inter-change, and condensing vapours passing from the partial condensation zone.

The residual product is introduced into an intermediate point of a second and independent fractionating tower operated under substantially the same conditions as the first tower, collecting and removing as a heavy distillate the product of condensation of the vapours leaving the top of this second tower. H. S. G.

712. Handling Crude Oil and Residuals. A. E. Miller, Assr. to Sinclair Refining Co. U.S.P. 1,646,760. Oct. 25, 1927.

A process of treating asphaltic petroleum oils or residues for separating constituents volatile below their cracking temperature from asphaltic residues non-volatile without substantial cracking of the separated volatile constituents, which comprises maintaining within a still a liquid body of asphaltic residues, preheating the oil to be treated under pressure, and preheating a neutral gas to a temperature in excess of 650 degrees F., mixing the preheated oil with a larger volume of the preheated neutral gas, reducing the pressure on the oil and then mixing it with the preheated neutral gas, spraying the mixture into the vapour space of the still and introducing a heated neutral gas into the still through the body of asphaltic residues, maintaining the temperature in the still at about 650° F., withdrawing the constituents volatilized, and withdrawing the asphaltic residues as a liquid substantially free from volatile constituents from the body thereof in the still. H. S. G.

713. Separation of Gasoline from Mineral Oil. A. E. Pew and H. Thomas, Assrs. to Sun Oil Co., New Jersey. U.S.P. 1,645,969. Oct. 18, 1927.

An apparatus in which it is possible to evaporate off substantially all the gasoline in a mineral oil while it is flowing over an extended surface in a thin layer without raising the temperature so high as to carry off an objectionally large proportion of higher boiling constituents.

The apparatus consists of a still comprising an elongated container adapted to hold a substantial body of oil, means to receive and laterally distribute oil in the upper part of the container, a flat upper pan slightly inclined in the direction of its length and the higher end of which is adapted to receive said oil, a plurality of lower pans arranged side by side under the upper pan and slightly inclined in a direction opposite to that of the upper pan, and means to distribute oil discharged from the upper pan to the higher ends of the lower pans, the combined widths of the lower pans being greater than the width of the upper pan to provide relatively shallower streams, thereby effecting evaporation on the lower pans of heavy gasoline fractions that have escaped vaporization on the upper pan. H. S. G.

See also Abstracts Nos. 654, 688, 728, 730, 731, 732, 733, 734, 735 and 746.

Engineering.

714. A Graphical Method of Determining Heat Transfer in Pipes. W. H. McAdams. *Chem. and Met. Eng.*, 34, 10.

By the method described the test data may be plotted to give a straight line, thus simplifying extrapolation. When the water flowing inside a condenser tube is in turbulent motion it has been shown that r_w, the resistance

on the water side, is proportional to $\frac{1}{v^{0.8}}$, where v is the water velocity. If we take b as the empirical constant, we have—

$$r_w = \frac{1}{bv^{0.8}}$$

and—

$$\frac{1}{u} = (r_v + r_t + r_s) + \frac{1}{bv^{0.8}}$$

where r_v, r_t and r_s are the thermal resistances of vapour to metal, the tube wall and any slime or crust.

If $\frac{1}{u}$ is plotted against $\frac{1}{v^{0.8}}$ a straight line is obtained with slope $= \frac{1}{b}$ and intercept on the heat transfer axis equal to $(r_s + r_t + r_v)$.

Tests on a new tube gave the formula—

$$\frac{1}{u} = \cdot0004 + \frac{1}{268_v{}^{0.8}}$$

(U in B.T.U.'s per hour per sq. ft. per ° F.)

On an old tube the formula—

$$\frac{1}{u} = \cdot00092 + \frac{1}{268_v{}^{0.8}}$$

was obtained, the difference in the constant being due to scale. This shows that the habit of employing a constant cleanliness factor for all velocities is unsound, since the effect due to scale is not a constant proportion of the resistance for all temperatures. Data obtained by Bray and Sayler for tubes condensing steam and benzol are also plotted on this principle. The method could be applied for such cases as oil heat transfer apparatus.

P. D.

715. Control of Corrosion. New Alloys. Mitchell. *Ind. and Eng. Chem.* November, 1927.

No definite alloy resistant to all corrosive substances being known, lists are given of the most important corrosion-resisting alloys of iron, nickel, copper and aluminium. A probable explanation of corrosion resistance is given. In the case of a pure metal, the "unsatisfied affinity" of the atoms for the atoms of some other substance determines its resistance to corrosion by that substance. If this affinity can be reduced by the presence of some other metal, as in the case of solid solutions, susceptibility to attack will be considerably reduced. On the other hand, intermetallic compounds, while on account of their greater stability they are more resistant to corrosion, are undesirable because of their unsatisfactory physical properties, being usually brittle and without toughness and ductility. They are of great importance however as hardeners in certain classes of alloys, particularly the strong aluminium alloys. Homogeniety of the metal is to be aimed at, as impurities aggregated at any point are apt to set up local potential differences. The liquid with which the alloy is to be in contact should be considered from the point of view of providing something in the alloy which will form an insoluble compound which in turn will provide a protective surface to the alloy.

A. R. S.

716. Centrifuges for Purifying Oil. Aktiebolaget Separator of Stockholm and H. Miller, New York. E.P. 271,526. May 23, 1927. Conv., May 24, 1926.

A centrifuge for the purification of oil without contact with the air, having a rotating bowl mounted to rotate upon a hollow shaft divided into inlet and

outlet chambers, the liquid to be purified being delivered through a pipe to the inlet chamber and on to the centrifugal bowl through radial passages, the purified liquid passing from the bowl into the outlet chamber in the hollow shaft through radial ports and thence to a discharge pipe, the rotating shaft being supported on bearings located on both sides of the centrifugal bowl. H. S. G.

717. Method of Heating at High Temperatures. C. Field. U.S.P. 1,403,471. January 10, 1922.

The method of heating described in the patent is an indirect one, the vapour of mercury being used as the heat carrier. The mercury is held in a boiler over a furnace of suitable form. The mercury vapour is passed through a superheating coil into the jacket surrounding the vessel wherein is the substance required to be heated. The mercury condensed in the jacket is returned to the boiler. Any gases given off by the mercury and not condensed in the heating jacket are passed through a water-cooled condenser where the major portion will be condensed and collected in a catch-pot. This is placed between the heating jacket and the vacuum pump used for obtaining low pressures within the system.

It is claimed that mercury having a much higher heat conductivity than steam, which has generally been used before, the efficiency of transfer will be so much greater, and the time required to bring a substance to a given temperature so much less. It is also claimed to be more efficient than oil baths and fusible metal alloy baths as used before. Further, that by heating the mercury under reduced pressure, the same medium can be used for heat transfer over a range of temperatures by merely altering the pressure in the system. S. W. C.

718. High-Temperature-Heating Method. C. Field. U.S.P. 1,619,660. March 1, 1927.

This is a furtherance of patent No. 1,403,471 and, whilst embodying the same general principle, effects certain improvements in the apparatus and method of carrying out the heat transfer. It provides firstly for improvements in the mercury boiler. From the bottom of the boiler a number of closed end tubes extend down into the furnace, and from the roof of the boiler a corresponding number of rods extend down concentric with the tubes so that only a small annulus is left between the rods and the tubes. The mercury is accommodated in these spaces and is thus presented in the form of a thin film to the furnace, by which means it can be heated rapidly. Further, besides the outside jacket for heat transfer in heating a substance, an internal perforated coil is provided so that the mercury vapour can be passed directly into the substance, and distillation carried on thereby. Fractional condensers are provided and a separating chamber from which the mercury is returned to the boiler. S. W. C.

719. Apparatus for Heat Transfer at High Temperatures. C. Field. U.S.P. 1,619,661. March 1, 1927.

This is another patent in the series describing the use of mercury for heat transfer. It differs from the others in providing electrical heating for the mercury, using the resistance of the mercury within the boiler to produce the heat. It provides for either internal heating with a closed coil or external heating from a jacket. It further provides for improved means for condensing any vapours not condensed in the jacket or coil. S. W. C.

720. Method of Heating and Cooling at High Temperatures. C. Field. U.S.P. 1,619,662. March 1, 1927.

This patent resembles the previous ones in all respects. It provides that the mercury may be furnace or electrically heated and that heat shall be transferred either through a jacket or from a plurality of internal tubes. In the case of the jacket, a cock is provided on the liquid outlet line which when closed leaves liquid in the jacket. With the internal tubes some liquid always remains in the bottom manifold. By this means some liquid can always be left in contact with the heated substance, so that when cooling is desired this will be evaporated by heat drawn from the substance and condensed in the condensers provided for the uncondensed vapours when heating is taking place. S. W. C.

721. Apparatus for Heating and for Controlling Reactions at High Temperatures. C. Field. U.S.P. 1,619,663. March 1, 1927

This patent provides for mercury heating by means of a jacket similar to the previous patents. Uncondensed vapours are condensed in a coiled pipe over which cold water trickles. The vacuum is maintained by means of a pump preferably of the hydraulic centrifugal type using mercury instead of water. The return pipe to the boiler, the pipe for condensed vapour from the jacket, one end of the condenser, and the intake and outlet lines for the pump are all connected to the same catchall. It is claimed that this entirely eliminates obnoxious vapours and greatly diminishes the rate at which the mercury is consumed. S. W. C.

722. Differential Thermometers. Secretary of the Board of Trade and C. V. Boys. E.P. 276,803. July 22, 1926.

A mechanically operated differential thermometer embodying a rigid foundation framing, upon which the fixed abutments for a hot and a cold expansible vessel and the fulcrum of the second motion-magnifying lever of a compound lever system are carried, whereby movements of the operative point on said lever are rigidly determined solely by difference of temperature of the two expansible vessels. The expansible vessels embody interior bellows, tubing and annular locating upper surfaces, and are supported solely at their upper ends by three compression members of glass, fused quartz or other rigid material of small heat conductivity and co-efficient of expansion abutting the rigid framing and a thin tension member supported by a pivot on the first motion magnifying lever, the lever itself being resiliently mounted upon said rigid framing. The foundation framing is integral with or is rigidly connected to a frame supporting the final indicating or recording arm, which is connected to the first motion-magnifying lever through the intermediary of two oppositely acting one-way struts or links whereby straining or possible damage of the mechanism in the event of abnormal motion taking place is avoided.

Although primarily intended for the purpose of a recording instrument, an indicating point moving over a scale may replace the pen where automatic records are not required, such small variations of temperature as one-four-hundredth of a degree centigrade being rendered visible. H. S. G.

723. Dispersion of Solids in Liquids. W. H. Whatmough. E.P. 276,727. May 29, 1926.

A process for the production of dispersions of solids in liquids, which comprises passing a mixture of solid and liquid through an apparatus consisting of relatively rotating flat discs or curved grinding members, one of

which is wholly or partly faced with a yieldable or flexible material, a relative linear or arcuate motion being superimposed. The mixture of solid and liquid is fed in at the centre of one of the grinding members, and means are provided to enable the clearance between the grinding members to be adjusted and maintained. H. S. G.

724. Dispersion of Solids in Liquids. W. H. Whatmough. E.P. 276,728. May 29, 1926.

A process and apparatus for dispersing solids in liquids by passing a mixture of solid and liquid between a pair of disc-like grinding members which are independently rotated about non-coincident fixed axes and have a substantial portion of their areas in wiping or smearing contact. One of the grinding discs is provided over the whole or part of its surface with a yieldable or flexible material, and the upper disc is provided with a central opening to enable material to be fed between the discs. The yieldable or flexible material may also either be inserted in the face of one or both of the discs or be arranged as an apron at the outside of the discs. The axes of rotation of the discs are adapted to be changed, and the clearance between the grinding surfaces diminishes in the direction of feed to enable coarse aggregates to be broken down prior to the smearing or wiping action, and is adapted to be adjusted and maintained. H. S. G.

See also Abstracts Nos. 678, 680, 688, 726, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750 and 751.

Antidetonation.

725. Improvements in Motor Fuels. Bereslavsky. E.P. 258,550. Sept. 30, 1927.

Mesitylene, aminomesitylenes and their derivatives are used as "anti-knock" dopes. Two per cent. diamino mesitylene in 2 per cent. ethyl alcohol added to spirit allows of an increase in compression pressure of 20 lbs. R. P. L.

726. The Quantitative Effect of Engine Carbon on Detonation. N. MacCoull and D. B. Brooks. *J. Automot. Eng.*, July, 1927, 59-63.

For the tests, a four-cylinder model D U-8 Waukesha motor truck engine was used, fitted with a special high-compression head, and of bore 4¼ ins., and stroke 6½ ins. Speed was maintained constant at 400 r.p.m. by a dynamometer, and the throttle was gradually opened until a standard degree of detonation was attained. The amount of throttle opening was measured by means of a mercury manometer connected to the intake manifold, the pressure thus being proportional to the throttle opening. A variety of standard fuels was made by adding known quantities of ethyl fluid to a special cut of Texaco spirit. The detonation points on the throttle were noted for these fuels during a 175 hrs. run. A steady decline in the intake manifold pressure was noted for the same degree of detonation, the decrease being most rapid in the first few hours. When absolute intake manifold pressure was plotted against weight of carbon deposit in the cylinder, a straight line relationship was observed. The relative effect of the carbon on the various parts of the cylinder and piston was observed by decarbonising first the cylinder head without touching the piston, and then *vice versa*. It was found that the increase in detonation due to carbon is proportional not to the total carbon present, but to the greatest thickness of carbon present over a considerable area. A popular carbon remover failed to produce a decrease

in the detonation. Actually, slightly greater detonation occurred, and no decrease could be noted in the actual weight of carbon deposited in the engine. W. N. H.

727. Quantitative Anti-Knock Testing. C. K. Reiman. *Ind. Eng. Chem.*, Sept., 1927. 1055—1058.

Details are given of an apparatus consisting of a 850 watt. Delco light set fitted with an electric dynamometer and a Midgly bouncing pin. The anti-knock properties of fuels are estimated by matching them against those of a blend of a standard mid-Continent spirit and aniline. It has been established that two fuels tested first with one compression head and then with another show the same relative knock characteristics. Curves are drawn showing the relation between aniline equivalent and the addition of tetra-ethyl-lead, benzol, iso-octane in n.heptane, Californian spirit, and vapour phase cracked spirit. A straight line relationship is observed in all cases except in that of benzol, each successive addition of which causes a greater anti-knock effect than the former addition. W. N. H.

See also Abstracts Nos. 658 and 661.

Cracking.

728. Control of Equilibrium Important Phase in Snelling Process. *The Refiner*. Sept., 1927.

The article discusses U.S.P. No. 1,624,848. Before going into a detailed discussion, however, a general non-technical description of the process of cracking is given. The process provides for the heating of a body of oil to a high temperature till a condition of equilibrium has been reached among and between the various hydrocarbons and then fresh oil is supplied to the body more or less continually and at a rate insufficient to disturb substantially the equilibrium relations within the body, one or more of the products of equilibrium being withdrawn simultaneously. To produce the equilibrium, in the case of a heavy oil, Snelling finds that a momentary heating so that a gauge pressure of 800 lb. is produced, suffices. The same results are obtained more slowly by heating to 660 lb. With light oils or gases the gauge pressure cannot be relied upon, but heating to 400°—600° C. produces the same result. Gauge pressures up to 2,000 lb. have been obtained, but the reaction is substantially the same as that at 800 lb. The same results can be obtained at lower temperatures and pressures by the use of a catalyst. He prefers to use the catalyst in the colloidal state, and then with a heavy oil equilibrium can be obtained at a pressure of 400—500 lb.

The purpose of the invention seems largely to produce a maximum yield of hydrocarbons of a saturated nature from a heavy oil. He attributes the formation of unsaturated products to the fact that the first products of the breaking-down of oil are largely ethylenic groups and in the ordinary operation the products are withdrawn from the zone of heat so rapidly that insufficient time is afforded for further rearrangement with saturation. He points out that the effect of heat and pressure upon oils is not, as is generally supposed, to produce only breaking down products, but that breaking down and reconstruction go on side by side. Thus the same products may be produced either by starting with a heavy oil or with a light oil or gas. He claims that under suitable heavy pressure and at high temperature he has converted propane and other gases into high-boiling hydrocarbons, some of which boil as high as lubricating oil. Under suitable conditions of volume and expansion space, temperature and pressure, an equilibrium is produced

in which there will be with one ratio of expansion space to liquid material about 16 per cent. of gasoline, and by continuous removal of a small quantity of this gasoline, more and more of it is formed. This gasoline he finds to be saturated and good, being wholly unlike the "cracked gasolines." He finds that the best ratio between volume of oil and expansion space for the production of gasoline from heavy oil is to have an expansion space between 5 times and 2 times the volume of heavy oil treated. He found that low boiling oils could be obtained from heavy oils with very much more economy if he restricted the escape of permanent gases to the lowest possible amount, but that some escape of permanent gases is advantageous. He gives as a possible reason for this that some methane and hydrogen are always produced and these gases are but little reactive, tending to go into equilibrium more slowly than the other products. Their retention, however, in the system prevents more methane and hydrogen being formed.

The article concludes by setting out 7 of the 16 claims allowed to Snelling in his patent. S. W. C.

729. The Synthesis of Fuels. M. Daniel Florentin. *Bulletin de la Société de Chemie Industrielle.* Seventh Congress of Industrial Chemistry. 1927.

The author divides the processes of synthesis into 5 principal groups :—

(1) The processes based on the pyrogenic destruction of heavy fuels.
(2) The methods of hydrogenation of carbon monoxide with or without pressure.
(3) The methods utilising the polymerisation of firstly the unsaturated hydrocarbons, and secondly of methane.
(4) The methods utilising biological processes.
(5) The methods of hydrogenation of heavy organic bodies, with division of the molecules or the splitting off of functional groups.

He rapidly reviews the various processes of the first group—the cracking of heavy hydrocarbons, carbonisation at high or low temperatures, etc., and then passes to the second group where he cites in particular the work of the B.A.S.F. (1913), M.M. Patart, Audibert, and of Professor Fischer, which deals with synthol, methyl alcohol, and hydrocarbons. Group 3 and 4 are dealt with rapidly, but group 5 is developed to greater length. Reference is made to the work of Bergius who effected the hydrogenation of heavy hydrocarbons. and partially of coal without a catalyst. Theoretical considerations (1923—1926) have on the contrary led MM. Kling and Florentin to utilise appropriate catalysts for each case. Thus, the temperature of hydrogenation is lowered and one is able to disperse the functional groupings in particular, the hydroxyl radicle of the phenols.

The recent writings of Dr. Krauch (director of the I.G.) absolutely ignore the previous work of MM. Kling and Florentin, with the result that the B.A.S.F. which has bought the Bergius process (in Germany) is using an analogous process to that of MM. Kling and Florentin and applies it to the transformation of liquite, at his works at Lenna. The author concludes by stating that the synthesis of fuels has entered on an industrial phase, and that one will soon be able to give an opinion on the respective values of the various processes. W. H. T.

730. Cracking, Catalysing and Hydrogenating Carbonaceous, Materials. A. E. Bianchi and G. Guardabassi. E.P. 278,041. May 27, 1926.

A process for cracking, hydrogenating or dehydrogenating carbonaceous materials at atmospheric pressure wherein the materials in fluid, molten

or comminuted form are continuously passed in a film or layer through a heated retort or series of troughs provided with revolving agitators. The gases or vapours arising from the materials treated are immediately passed through a fog or cloud of dust or smoke at the same temperature which is formed during the process and retained as long as practicable in the reaction chamber. The gases or vapours are then brought into contact with chains coated with successive catalysing agents of different kinds in the same apparatus, suspended from a reticulated screen and continuously vibrating, whereby the reactions are promoted. H. S. G.

731. Method of and Apparatus for Cracking Oil. F. M. Hess. U.S.P. 1,638,335, 1927. Appl. 24.1.23.

The oil is distilled under pressure in the form of a thin moving film and a portion of the residue converted into gases rich in hydrogen by combustion in a converter with a mixture of air and steam. The hydrogen-rich gas is used to heat the incoming oil, air and steam and is then introduced into the oil stream. H. G. S.

732. Improved Process of and Apparatus for Cracking Hydrocarbons. H. J. Jansen, Jun. E.P. 278,235, 1927.

The process consists in passing the oil in a substantially horizontal direction and at high velocity through a molten metal, preferably lead covered with a layer of molten zinc chloride, the molten metal having only a small free surface at the vapour outlet end. If residuums, asphaltic or high carbon-content oils are employed, the process is carried out in two stages, means being provided to withdraw the heavy residue at the end of the first stage. H. G. S.

733. Improvements in Apparatus for Cracking Oils. O. Kay. E.P. 276,947, 1927.

The invention introduces an entirely novel method of cracking oils, based upon the fact that the raw material is made to bombard the inner wall surfaces of a double frusto-conical rotating nozzle whereby the heavy molecules are thoroughly broken up. The oil is sprayed against the cones by means of compressed air and the product, which emerges as a spray, is fractionated by directing the spray into a series of receptacles so placed that gasoline collects in the receiver furthest removed from the cones and heavy oil in the receiver nearest the cones. The application of heat is not mentioned, one of the objects of the invention being the elimination of temperatures usually employed in the art of oil cracking. H. G. S.

734. Distilling with Aluminium Chloride. A. Mc.D. McAfee. U.S.P. 1,636,144, 1927. Appl. 20.7.25.

Raw cracking stock is distilled in presence of aluminium chloride which has become partially exhausted by previous application, the treated oil being redistilled in contact with the aluminium chloride which accompanied the vapours to the second still, fresh chloride being also introduced into the second and subsequent stills. H. G. S.

735. Process and Apparatus for the Conversion of Heavy Petroleum Oils into Lighter Oils. V. W. Northrup. U.S.P. 1,642,624, 1927. Appl. 20.11.24.

The vapours of the heavy oil mixed with a gas "having available hydrogen," *e.g.*, methane or natural gas, are subjected to an alternating current field of

2,000 to 8,000 volts in one zone without substantial cracking taking place and then passed over catalysts at 373° C. to 537° C. in a second zone independent of the first. H. G. S.

736. Improvements in the Cracking of Petroleum Oils and the Carburetting of Water Gas. Petr. Chem. Corp. and E. P. Stevenson. E.P. 273,781, 1926.

Addition to E.P. 248,375. Petroleum distillates such as gas oil are cracked in the vapour phase and the liquid products separated by condensation. The cracked gases are subjected to cooling and compression to eliminate hydrocarbons such as butane, the residual gases being then scrubbed with reagents like concentrated sulphuric acid to remove propylene, butylene and the like, the final product being admixed with lean commercial gas. The separation of a number of valuable chemical raw materials is thus effected. H. G. S.

737. A Process for Transforming Methane into a Carburetting Agent similar to Petroleum. H. Spindler. E.P. 255,493, 1926.

Methane, alone or mixed with gases capable of uniting with hydrogen, *e.g.*, acetylene or carbon monoxide, is heated to from 500° to 950° C. in one stage, cooled to between 250° to 350° C. in a second stage and then subjected to the action of catalysts in a third stage. The catalyst consists of a mixture of zinc chloride, active carbon, aluminium powder, magnesium powder and iron scale previously treated with alkali hydroxides, the whole operation being conducted under a pressure of 70 to 200 atmospheres. The product is liquid and exhibits the characteristics of petroleums of different origin. H. G. S.

738. Treating Hydrocarbons. R. de M. Taveau. Assr. to Texas Co., New York. U.S.P. 1,645,553. Oct. 18, 1927.

A process of converting higher boiling hydrocarbons into lower boiling ones that comprises maintaining a body of oil in a still, applying heat to the bottom of the still to heat the oil to a vaporizing temperature while retaining a quiescent pool of aluminium chloride material within the still, the pool being spaced and separated from the heated bottom of the still, periodically charging fresh oil into the still and adding aluminium chloride to the pool and separately drawing off liquid from the pool and from the bottom of the still. H. S. G.

739. Method of and Apparatus for Treating Hydrocarbons. C. P. Tolman. U.S.P. 1,643,036, 1927. Appl. 26.8.26.

The oil in the vapour state is commingled with mercury vapour superheated to above the desired cracking temperature, the pressure on the reacting components being below 50 pounds per square inch. Substantially the whole of the heat required for cracking is supplied from the heated mercury. H. G. S.

See also Abstracts Nos. 648, 660, 661, 662, 712 and 721.

Oil-field Technology.

Papers Dealing with A.P.I. Specifications.

740. Progress in Wire Lines and Cordage. C. C. Sharpenberg. *Oil and Gas J.*, 1927, **26** (18), 128.

The advantages gained by the standardisation of rope and cordage specifications are :—

The value of proper grooves in sheaves has been set out and the use of wear-resisting steels or alloys has been accelerated. Records show that thousands of feet can be drilled by rotary without changing sheaves when the grooves are correctly designed.

Bending stresses in wire rope are more completely understood. The first properly grooved rotary drum, 25 inches in diameter, is in use and others will soon be on trial.

The stresses imposed in service have been studied. At a well where wire lines gave short service a strain of 42,500 lb. was observed on the line, with an additional bending stress of over 16,000lb. on a 16-inch drum. A new line is only guaranteed under present A.P.I. standards to 69,000lb. breaking strain. This shows that a more complete understanding of service conditions by users and manufacturers should be of value.

Wire ropes are now received in the field properly lubricated and this helps to prolong its life.

Attached to the A.P.I. specification are three appendices, A, recomended practice for use and preservation, B, suggested improvements in design of plant to lengthen life of rope, and C, field troubles and causes. G. S.

741. Rig and Derrick Standardisation. W. W. Fondren. *Oil and Gas J.*, 1927, **26** (18), 136A.

When the A.P.I. Committee on Rigs and Derricks was organised in 1924 it was found that nearly 200 sizes of derrick were in use, and innumerable rig parts.

A.P.I. derricks can be obtained in practically any height, and have a uniform water-table opening permitting interchangeability of crown blocks. Two systems of base dimensions are used. One permits the changing of derricks on the same base or a 20-foot base derrick may be erected on a 24-base without disturbing the larger derrick. Another system, the standard taper, provides one derrick which is shortened from the base to provide any height. Derrick dimensions have been standard as far as practicable.

The working capacity of the derrick is fixed and a data plate attached, including particulars of wind load. G. S.

742. Vital Importance of Uniform Gauges. H. W. Fletcher. *Oil and Gas J.*, 1927, **26** (18), 136L, 299, 324.

The chief aim of standardisation is the promotion of interchangeability and also to provide specifications for manufacture and inspection.

The first step is to obtain a set of dimensions generally acceptable, and this requires adjustments of conflicting requirements. A system of inspection is then necessary, and a table of dimensions is usually sufficient to enable the production of standard size goods. Direct measurement with scale, etc., is often sufficient to insure accuracy.

The measurement of screw threads, consisting of seven separate elements, requires a gauge different from the scale or micrometer. This gauge measures the combined effect of five of the elements, roundness, thread length, pitch diameter, thread angle and lead. Major and minor thread diameters do not require checking.

The A.P.I. thread gauge consists of a threaded plug attached to a threaded ring. The plug is the ideal male thread and the ring determines the extent to which the work corresponds with the plug. Three types are in use, one for casing, one for tool joints and one for sucker rods.

Manufacturing processes are so accurate that errors in gauges are negligible

compared with the allowable tolerance on the product. All gauges are certified by the Bureau of Standards.

Drill-pipe threads are permitted to vary, ± one turn from ideal gauge fit, a maximum variation of four threads from maximum pipe to minimum coupling and *vice versa*. Prints illustrating gauging practice are prepared enabling all gauges to be applied in a standard manner. G. S.

743. Problem of Selecting Sucker Rods. Robert N. Burnett. *Oil and Gas J.*, 1927, **26** (18), 137, 302, 305.

Sucker rods form a large item in production costs and endeavour to find good rods is needlessly lengthy. The steel which has the greatest ultimate strength, the highest yield point and the "best ductility," is usually given preference, but the two points to be considered are the efficiency of the steel when made up as sucker rods, and its length of service. These cannot be answered by physical properties or by the field man.

Rod stretch is usually computed and the stroke adjusted on the pitman crank. Such computations are usually based on the proportional elasticity of steel being 0·003 per cent. per 1000 lb. of unit stress, the modulus of elasticity being assumed as 30,000,000. Taking the case of a 5000-foot well, using a 48-inch stroke pump with a capacity of 1·04 gallons, the total load may cause a stress of 15,000lb./sq. in. on the top rod. The average stress of 7500lb./sq. in. multiplied by 0·003 gives a stretch of 13½ in. If the basic assumption were correct this would be all right. Tests of 20 specimens gave 0·00321 to 0·00351, the corresponding stretch being 14·4in. and 15·8in., a difference of 0·03 gallon of oil per stroke in favour of the former. It follows that the modulus of elasticity should be a prime factor in rod selection.

As regards endurance, two simple tests are available, one to determine fatigue endurance limit, and the other fatigue resistance of the made-up coupling. For the former a rotating beam machine is used, and for the latter a machine has been devised in which the rod is alternately subjected to flexing and tension. G. S.

744. Belting Committee had Difficult Task. A. H. Rincy. *Oil and Gas J.*, 1927, **26** (18), 138, 142, 380, 383, 384, 386, 388, 390, 392.

As no great study had previously been made to study belt data in any detail, the A.P.I. Belt Committee had to inaugurate its own research and field study. Manufacturers and engineers co-operated and the results obtained are believed to be conclusive on some points and tentative on others.

The kinds of belts dealt with were those in common usage in the oil industry; *i.e.*, balata, leather, solid woven cotton, solid woven hair, stitched cotton fabric and rubber.

Strength of Belts.—This was considered of fundamental importance and after a large number of tests it was decided that a good oilfield belt should be load-resistant, according to the following values of ultimate tensile strength:—balata, 300lb. per inch of width per ply; leather, single, 600lb. per inch of width, double 1100lb. per inch of width; rubber, 340lb. per inch of width per ply; solid woven cotton, single, 1200lb. per inch of width, double, 2000lb., triple, 2500lb.; solid woven hair, single, 1200lb. per inch of width, double, 1300lb., triple, 1400lb.; stitched cotton fabric, seven plies or less, 300lb. per inch of width per ply, over 7 plies, 275lb.

Elongation characteristics.—Ability to stretch on application of a sudden load is closely allied to the ability to withstand a large load and typical elongation curves are the basis of the A.P.I. specification.

Fatigue.—Fatigue was considered to mean any type of failure caused by running the belt. A time-tension study of belts was made so that tension

could be measured and loading and running varied. The apparatus consisted of two roller bearings, sliding base, countershafts, the driving countershaft being fitted with a 40-inch diameter pulley and a 13¾ inch eccentric pulley, power being supplied from a 15/35 h.p. variable speed motor. The driven shaft was fitted with a 40-inch and a 15-inch diameter pulley, power being supplied through the test belt running between the 13¾in. and the 15-in. pulley. Load was supplied to the driven shaft by a belt from the 40-inch pulley to a 15/35 variable speed motor driven to act as an electrical brake. An idler pulley suspended on the driving side of the test belt could be used to tighten or slacken the belt, and being attached to a tension dynamometer measured the downpull in order to calculate the tension.

The results obtained can only be considered as preliminary, but the following facts stand out:—1. All breaks were at the belt splice; 2, the strength of factory splices varies on different belts of the same manufacture; and 3, apart from breaks, the only visible effect was wear on the friction side, due to slip.

Elasticity.—Tests were made to determine the belt's ability to return to original after elongation, due to imposed load. The conclusions given are tentative, subject to further research: 1, Power transmission efficiency is proportional to ratio of recovery; 2, losses accompany an elastic efficiency of less than 100 per cent., and are cumulative, as well as ascendant in magnitude; 3, belts may be made elastically efficient by: (*a*) running in, or (*b*) stressing slightly over working stress; 4, the effective life of a belt is the period which it possesses perfect elasticity; 5, the coefficient of static friction should not only be a maximum but stable; 6, changes of humidity and temperature affect elasticity, but are only of secondary importance; 7, manufacturers are not responsible when abuses in use impair elasticity.

Fasteners.—The weakest point in a belt is nearly always the clamp. A large amount of data has been collected on clamps, and the following essentials are supported by field usage:—1, Alloy steel bolts of S.A.E. No. 2330 or better, S.A.E. thread without upset; 2, Nuts not case-hardened, tolerance as for bolts; 3, 1-inch radius, 90° bend for clamped ends of bolts; 4, soft cushion or shoe; 5, curve to conform to crown of engine pulley; 6, light weight; 7, no lock washers; 8, taper on thread end of bolts; 9, rust-resisting material; 10, bolting arrangement to require only one wrench; 11, bolt centres not over two inches; 12, clamp corrugated inside; 13, filler of corrugated metal; 14, top end of bolts bent back by action of filler.

Marking.—A number of methods of marking were tested and it was found that Duco paint may be used for rubber belts, steel die stamping for leather belts, rivets for all types, metal tags on clamps when the record taker also installs, replaces and shortens the belt, metal or linen tags are not practicable.

Care and Usage.—A guide for the care of belting is included in the A.P.I. specification, as follows:—1, Belts should be kept tightly rolled until ready for use; 2, a square should be used in cutting belts and marking bolt holes; 3, Use a small punch or drift pin in making holes in hair or fabric, and a punch $\frac{1}{32}$-in. smaller than the bolt for other belts; 4, keep clamp bolts tight; 5, replace clamp filler when worn; 6, keep pulley faces free from dirt; 7, Do not allow water, tar, etc., to get on belt or pulleys; 8, Do not use metal inner tubes, stick dressing, paraffin, etc., for belt dressing; 9, if the recommended dressing is not available use only vegetable castor oil on belts other than leather; 10, use neatsfoot oil on leather belts; 11, do not run the lap against the pulley; 12, keep pulleys in alignment; 13, keep all belt on the pulleys; 14, do not allow belt to rub on any part of belt house; 15, run belt as loose as possible; 16, release tension on belt when power is shut down; 17, use proper clamps; 18, horse-power transmitted, see manufacturers' tables; 19, store

belts in the cool; 20, use belt stretchers or soft rope in applying belts to pulleys; 21, keep belt house weathertight and drained; 22, keep accurate belt records.

A standard form has been adopted for the keeping of belt records. G. S.

745. Specifications Completed on all Pipe. J. Edgar Pew. *Oil and Gas J.*, 1927, **26** (18), 155, 158, 162.

Complete specifications are now available on all grades of pipe used in the oil industry. The four classes of tubular goods dealt with are: 1, Casing, 4½-in. O.D. to 24½-in. O.D.; 2, drill-pipe, 2⅜-in. O.D. to 6⅝-in. O.D. 3, tubing, plain, 2-in. to 4-in., external upset, 1¼-in. to 4-in.; 4, lime pipe, threaded and plain end, ⅛-in. to 20-in. O.D., plain end only, 3½-in. to 24-in. O.D.

The establishing of definite thread and gauge dimensions to insure interchangeability should prove a boon to manufacturers. The question of clearances is also important, especially in casing for deep holes, as shown by the following. With present old-style sizes, 5 $\frac{5}{16}$-in. inside 6⅝-in. gave clearances of 0·143 in. to 0·203 in., but with A.P.I. 5⅝-in. O.D. inside 8¼-in. O.D. the clearances are 0·311 to 0·461 in. the increase in favour of A.P.I. sizes being 0·168 to 0·258 in.

The principal requisite in tubing is a tight joint with a thread capable of withstanding repeated screwing and unscrewing. In the smaller sizes the thickness of the material prevents the use of the 11½-thread but on the upset 10-thread can be used. G. S.

746. Standard Steel Tanks for Oil Storage. Ralph J. Reed and Mark W. Daw. *Oil and Gas J.*, 1927, **26** (18), 169, 172.

Steel tanks for oil storage fall into two general classes—the lightweight sectional bolted tank and the heavier riveted steel tank.

For bolted tanks, eight capacities are standardised with six diameters, and it is possible for the 500 and 1000-bbl. tanks to be either a single- or double-course shell.

A.P.I. Bolted Tanks.

Nominal Capacity. Bbls.	Diameter. Ft.	ins.	Height. Ft.	ins.
100	9	2½	8	0½
200	9	2½	16	1
250	15	4½	8	0½
500	15	4½	16	1
500	21	6	8	0½
1000	21	6	16	1
1000	29	8½	8	0½
2000	29	8½	16	1
5000	38	7½	24	1½
10,000	55	0	24	1½

All bolts 2-inch pitch, 2 in. centre, the centre between rows. Double-boltep seams to be square pattern. Water seal roofs figured for 9 in. of water. Pitch of cone roofs, 1 to 12 in. Standard sheets, 60 × 100 in.

For riveted tanks, the first step was the adoption of a standard plate size and a width of 72 in. was chosen. The length of the plate was finally fixed at approximately 19 feet.

It was agreed that requirements would be met by a series of tanks of seven diameters, as follows :—

A.P.I. Standard Tanks.

Diameter Feet.	Capacity in Barrels. Height.				
	23ft. 6in.	29ft. 6in.	35ft. 0in.	41ft. 0in.	47ft. 0in.
36	4,400	5,500	6,500	7,600	—
48	7,300	9,400	11,000	13,000	—
60	—	15,000	18,000	21,000	—
78	—	25,000	30,000	35,000	—
102	—	43,000	51,000	60,000	—
120	—	59,000	70,000	82,000	94,000
144	—	85,000	103,000	120,000	138,000

Tentative lay-outs show that the complete range can be built with only fifteen thicknesses of plate and for the 82,000-bbl. downwards only ten thicknesses are required.

It has been common practice to specify a safety factor of 2·5, but for A.P.I. tanks a factor slightly greater than this is used. G. S.

747. Rotary Drilling Accomplishments. R. A. Wilson. *Oil and Gas J.*, 1927, **26** (18), 177–178.

The first work of the A.P.I. Committee on Rotary Equipment was to survey existing equipment, which showed an endless variety of types and sizes.

One of the first standards completed was drill pipe, followed by taper joints. In one district alone twenty-eight different sizes of fish-tail bit shanks for 4-in. drill-pipe were found.

The result of standardisation is that there are now only 7 standard taper joints.

In transmission gear, the standards adopted are for size of shafting, keys and chain, and sprocket tooth form. In shafting sizes, the $\frac{1}{16}$-in. diameters have been eliminated between $\frac{1}{2}$ and 4-in., and the $\frac{1}{8}$ and $\frac{1}{4}$ between $4\frac{1}{2}$ to 6 in., and the $\frac{1}{8}$, $\frac{1}{4}$ and $\frac{1}{2}$ over 6 in. G. S.

748. Standardisation of Oil Field Boilers. S. J. Dickey. *Oil and Gas J.*, 1927, **26** (18), 188, 192.

In the past one manufacturer may have called a boiler of 450 square feet heating surface a 50-h.p. boiler, while another would call a 600 square feet heating surface boiler as 50-h.p.

In order to have a uniform basis the A.P.I. Committee have specified 10 square feet of heating surface as one boiler horse-power.

Construction features were considered, and it was agreed that A.P.I. boilers must be built according to the A.S.M.E. Boiler Construction Code.

All A.P.I. Boilers have the same size pipe connections, thus facilitating the connection of boilers of different sizes in batteries. A standard list of fittings has also been prepared.

The standardisation of further minor items, such as internal clearances, is also under consideration. G. S.

749. Cable Tool Joints Standards Finished. Thomas Fleming, Jr. *Oil and Gas J.*, 1927, **26** (18), 218, 220.

The I. and H. has been recognised by the oil industry for some time, but variation in shop templates did not allow of interchangeability unless all joints were made by one maker.

The A.P.I. Committee found that the thread of the I. and H joint closely approached the U.S. Standard 7-thread flat and eleven sizes of joint were agreed on. G. S.

750. A.P.I. Pumping Equipment and Engines. T. E. Swigart, John R. Suman, and P. B. Roberts. *Oil and Gas J.*, 1927, **26** (18), 267, 271, 272, 272c.

Tubing, sucker rods, pumps, etc., have been standardised, and are already in use. Foundation bolts, clutch flange connections of engines and methods of engine rating have also been developed.

Specifications for 2 to 4-inch plain tubing and for 1 to 4-in. upset have been adopted. The longer thread engagement of A.P.I. tubing makes a stronger joint capable of withstanding making and breaking for a longer period than with the old style. Plain tubing is threaded 11½ and upset 10, except 3½ and 4-in. plain which has 10 and 1½ and 1½-in. upset which has 11½ threads.

A standard design and gauging system has been adopted for ⅝, ¾ and ⅞-in. sucker rods. Pin diameters of rods have been increased to give greater strength, thus the ¾-in. rod has a nominal outside diameter of 1 1/16 in. Threads are 10 per in., flat form, with provision for a vanishing thread. Couplings for double-pin rods are larger in diameter than the pin coupling to prevent wear of the pin collar. The A.P.I. sucker-rod joint is designed so that the face of the coupling makes contact with the face of the pin coupling. It is believed that the A.P.I. design of rods will meet the requirements of present deep wells; *i.e.*, up to about 6800 feet.

Cold drawn and machined working barrels have been standardised and also working barrel pump parts. Working barrels are standardised in 2, 2½, 3 and 4-in. sizes, and for pump parts it has been found possible to adopt eastern standards for the 2-in. and western practice for the other sizes. Fittings are suitable for either cold, drawn or machined barrels.

It was found difficult to standardise many mechanical parts of internal-combustion engines, but standards have been adopted for bolt-holes, foundation bolts and clutch flange connections. A standard method of rating gas, gasoline and oil engines has been developed to express average maximum b.h.p. at (*a*) recommended operating speed for pumping, and (*b*) tested speed of maximum power.

As regards pressure gauges, it is recommended that (*a*) taps and pressure gauges at well heads are to be ¼-in. standard pipe sizes, (*b*) pressure gauges are to be bushed for ¼-in. male pipe connection before delivery to the field, and (*c*) gauges are to be fitted with valve or stopcock under gauge before delivery to the field. G. S.

751. Standardising Gas Wells' Open Flow. R. R. Brandenthaler, E. L. Rawlins, and T. W. Johnson. *Oil and Gas J.*, 1927, **26** (24), 82, 90.

In order to determine if differences existed in open flow volumes of gas wells through different diameter well-head nipples and the relationship between such volumes, a series of open-flow tests were made in the Chickasha gas field, Oklahoma. The Pitot tube method was used and 11 wells, whose open-flow volumes through 8¼-in. casing ranged from 2,500,000 to 51,000,000 cu. ft. per day, were tested, work pressures varying from 165 to 890lb./sq. in. The intake arm of the Pitot tube was held rigidly parallel to the line of flow at a distance from the wall of the nipple equal to ¼ the diameter of the nipple. The 4-in. nipple had a Pitot tube attached. When fitting nipples the well was shut in and after opening the master valve the gas was allowed to blow

for fifteen minutes before the velocity pressure was recorded. The open-flow volume was calculated on the formula :

$$Q = 1{,}367{,}000 \frac{Ed^2}{G} \frac{[(P_1)0{\cdot}213 - 1]}{P_2}$$

where Q = open-flow volume in cu. ft.
E = efficiency factor = 0·92.
d = internal diameter of well-head nipple.
P_1 = velocity in lb./sq. in.
P_2 = atmospheric pressure (14·4lb./sq. in.).
G = gravity of gas (0·575).

$0{\cdot}213 = \frac{n-1}{n}$; n = ratio of specific heat, or

n = 1·27 for natural gas.

To convert gravities other than 0·575 for comparison it is necessary to multiply open-flow volume by

$$\frac{\sqrt{G_1}}{0{\cdot}575}$$

where G_1 is the gravity of the gas concerned.

Until experiments prove otherwise, a standard length of nipple should be used, and it is suggested that the Pitot tube be mounted on the nipple. Results show that open-flow tests may be standardised by reduction to a standard basis ; *e.g.*, through 6 or 8¼-in. or other diameter nipple. Open flows may be taken through smaller nipples with less waste of gas. G. S.

752. Hazardous Drilling in Swamp Area. James H. Dameron. *Oil and Gas J.*, 1927, **26** (20), 31, 140.

The Lockport Field, Louisiana, is situated in the swamps of Calcasieu Parish, and has many unique features. The depth of the soft murk is about 60 feet, and tramways have had to be built to get equipment to locations. Derricks are built on 40-square mats of 2in. × 12in. × 20ft. timbers and foundations are cribbed to the mat. The vibration makes it necessary to jack the derrick occasionally. Twin boilers are used for drilling, and are placed on a platform near the well. Mud is supplied from a central mud-mixer and carried to the wells in trucks. Wells are started with a 22-in. hole and are cased with about 100 ft. of 18-in., 1250—1600 ft. of 13¾-in., 3800 to 4400 ft. of 9⅝, and completed with 6⅝-in. and a 4½-in. screen liner. The central machine shop is one of the most complete known.

The net production of the field is about 5300 bbls. daily, but the majority requires treatment to bring it to less than ½ per cent. B.S. Since its discovery in September, 1924, the field has produced about 3,200,000 bbls. of oil, and now has 14 flowing wells, two on air and seven pumping. The producing area is about 1 mile by ½ mile. Tremendous pressures are met with in this field, and special precautions are taken to avoid the fire hazard, which is large.
G. S.

753. Secondary Methods of Oil Production.—The Mining Method. Part I. *Pet. Times* Nov. 5, 1927.

The recovery of oil from sands by pumping and flowing methods does not account for more than 20–25 per cent. of the total oil in the sand. Mining, on the other hand, is known to result in a recovery of 60–75 per cent. of the total, although the capital cost of putting the latter method into practice is relatively great.

Experience at Pechelbronn, Alsace, seems to indicate that the method

can be practically applied in certain cases, as there all the problems of ventilation, drainage, lighting, hoisting and breaking of the ground have been solved.

Oil mining is not possible under high-pressure gas conditions, or where there is a possibility of striking a pocket of high pressure gas in the workings. Mining methods, therefore, are not competitive with gas flow methods, but are merely supplementary after other methods have ceased to yield oil in paying quantities.

Shafts can be sunk through water bearing strata, but the expense is great, while some oil sands are so little cemented that they tend to flow like quicksand under very slight hydro static pressure. Under these conditions, oil mining becomes difficult, as galleries driven in such material would require special support and also the sand would be carried in the oil into the mine workings, clogging the drainage system and pumps.

In cases of petroleum occurrences where movement of the oil through the sand is so sluggish as to make pumping unproductive galleries can be driven through the lower part of the oil sand horizontally, and, in the opinion of Uren, the oil will drain by gravity into the channels, whence it can be recovered.

A. R. S.

754. Secondary Methods of Oil Production.—The Mining Method. Part II. *Petr. Times*, Nov. 12, 1927.

The Ranney system differs from the practice at Pechelbronn in that the galleries are not run into the oil sands themselves, but into the adjacent shale or other consolidated rocks. The introduction of pipes at intervals into the sands serves as a means of draining the oil off by gravity. It is estimated in an experimental mine at Jacksboro' in Texas that the cost of equipment and works will work out at 12–30 cents. per barrel under favourable conditions. This includes a reinforced concrete lining to a depth of 800 ft.

Another system by E. M. Carter uses a shaft sunk to the stratum below the oil sands and a gallery 30 ft. in length, driven along at the foot. Holes are drilled upwards into the sands, and the oil flows by gravity to a sump, whence it is pumped up the shaft to the surface.

Rich's method requires the entries driven along either above or below the sands, but as near as is practicable, and modifications such as the use of steam, gas, air, etc., are suggested. These tend to reduce capital costs.

Still another method consists in sinking a shaft into the productive area and then drilling holes radially, with a diamond drill, two or three inches in diameter to a distance of half a mile from the shaft. Caving difficulties would necessitate the use of perforated pipe, which would be difficult to introduce, but it is said that the use of vacuum will increase the flow considerably.

The methods detailed above are reputed to be safe in operation, and the recovery compares favourably with artificial pressure recovery through wells.

A. R. S.

755. Process for Separating Oily Emulsions. G. W. Coggeshall and A. Reilly, Assrs. to Jefferson Construction Co. U.S.P. 1,643,698 of Sept. 27, 1927.

The invention comprises a process comprising two separate steps; first, the treatment of the emulsion with a sulpho-acid compound, and second, a treatment with a salt solution (alkali metal and alkaline earth metal chloride). The treatments are generally carried out at atmospheric temperature, though heat may be used where advantage is so gained. The mixture is thoroughly agitated after each addition. One-half to two pounds of the sulpho-fatty acids are mixed with 2 gallons of water, and one and one-third gallon of this

solution added to each barrel of the emulsion. Kerosene may be used as a vehicle for the sulpho acid or an emulsion may be formed with a heavy oil, but neither of these are quite so satisfactory as the water solution. If the salts of the acids are used instead of the acids themselves they should be followed by the addition of a small percentage of an acid. The mixture is then treated with the salt solution, about 3lb. of salt to 1½ gal. of water, making about 1 per cent. of salt calculated on the oil treated. After further agitation the mixture is run to settling tanks where the oil can be drawn off.

S. W. C.

756. Process for Treating Emulsions. G. W. Coggeshall and A. Reilly, Assrs. to Jefferson Construction Co. U.S.P. 1,643,699 of Sept. 27, 1927.

The invention provides for an agitation of the emulsion with an emulsion-breaking agent, such as a soap solution, followed by a further agitation with a neutral solution of an alkali metal salt, thereafter allowing to settle. The mixture may be heated or not, as required. The quantities suggested are 0·2 per cent. of a 1 per cent. soap solution, followed by 1½ per cent. of a 20 per cent. salt solution. S. W. C.

757. Oil Purifying Apparatus. F. H. Hodge. U.S.P. 1,646,481 of Oct. 25, 1927.

An apparatus for use on oil fields for purifying crude petroleum by heating and washing with water whereby removing all fresh and salt water and foreign matters such as mud, etc.

The apparatus comprises an oil reservoir, an upwardly inclined supported heater connected with the reservoir, a water jacket surrounding the major portion of the heater, a smoke stack connected with the heater, a water stand-pipe disposed vertically entirely within the stack, a pipe connecting the lower end of the water jacket with the lower portion of the reservoir, a pipe connecting the upper end of the water-jacket with the lower end of the stand pipe, a horizontally disposed pipe connected with the top of the stand-pipe within the stack and leading to and within the oil in the upper end of the reservoir, and a spaced jacket surrounding said horizontally-disposed pipe. H. S. G.

Petroleum Geology.

758. Recent Research in Making of Oil. Pratt. *Oil and Gas J.* September 29, 1927.

Two theories as to the possible origin of petroleum are enunciated. The earlier, inorganic theory supposes that elemental hydrogen and carbon present in the original lifeless earth are brought together under conditions of excessive temperature and pressure and thus form oil. Support for this theory is given by the fact that oil and allied gaseous hydrocarbons occur, even though rarely, in or associated with igneous rocks, that hydrogen and carbon-bearing gases escape from volcanic vents, that metals such as nickel which presumably come from igneous sources are present in petroleum ash, and that helium, an inert gas which must come from igneous or inorganic rocks is a common constituent of natural gas. It is also argued that if inorganic rocks held more pore space petroleum would more generally be found there.

The organic theory supposes that in past ages the mud and sand carried down by rivers carried and deposited with it microscopical marine and swamp life. The pressure of constantly increasing depth of deposit sealed in this marine life, which the organic theory holds to be potential oil, and the sands and muds broken and thrust above the sea surface by movements of the

earth's crust round and beneath them, became the shales and limestones of to-day. The petroleum so formed and disseminated uniformly through the rocks is accumulated in part by pressure which transforms the mud into a dense shale and drives the oil into the more open grained rocks, and also by water moving down through the bed from its outcrop on the surface or rising upward under pressure from greater depths, which flushes the oil ahead of it and finally accumulates it in the top of a fold. The material which contributes most to the formation is present as microscopic life in shallow water and is known as plankton. Minute plants, diatoms form almost entirely rock sheets thousands of feet in thickness in California, and these diatomacious rocks are in close association with oilfields and are themselves oil-bearing in places. Microscopic animals, foraminifera, also abound in the plankton.

The researches of C. F. Tolman have shown the formation of oil, however, to be a direct product of vital process. He found that diatom epidemics in which millions of diatoms are thrown up on the beach, along with oil consisting of hydrocarbons and sulphur, occur along with an unusual influx of fresh water into the sea. The fresh water breaks up the diatom shell and the hydrocarbons which the plant has the power of making from water and carbon dioxide are consequently not absorbed by the plant but are thrown up along with it. These facts thus explain why in the diatom beds of many fields most oil is present where the diatom structure is most destroyed, a fact not otherwise satisfactorily explained. A. R. S.

759. Advances in Petroleum Geology. *Petr. Times*, 1927, xviii. (458), 783–784.

Results of the first year's work in petroleum research by the American Petroleum Institute have been published in a bulletin published by that Institute. In order to study the generation of oil in rocks by shearing pressure, tests were made on Colorado shales by deforming cores cased in tubes to an elliptical cross-section. These tests failed to produce oil or soluble hydrocarbons from the organic matter, and it is apparent that the extraction of soluble matter requires careful study. Attempts to measure the heat of friction also failed. Concentrated organic matter from Colorado, Utah and Kentucky, when subjected to X-ray analysis, gave diffraction patterns unlike any known mineral constituent of shales. They are undoubtedly of organic crystals and are being further investigated.

The object of the micro-furnace study of source rocks is to secure information as to the origin of oil and as to the relative amounts of oil which can be artificially produced from the rock components. Thin sections of the rock are heated in an inert atmosphere in a micro-furnace and the behaviour of the visible physical constituents observed. Some of the work requires further tests, but observations show that: (1) different constituents differ in their chemical nature, (2) ground mass changes occur at temperatures lower than those of plant remains, (3) the yield of oil and gas decreases on admission of air or oxygen, (4) optical properties are distinct and change with change of temperature, (5) supposed spore exines are not inorganic and the colonial algæ described in bogheads are plant remains, (6) solubility changes suggest experiments of scientific interest and economic value. The conditions of sediment accumulation to-day are being studied and collecting instruments have been devised. The dried sediment is destructively distilled and all types yielded small quantities of an oil.

Diatoms as an oil source are being studied and one to two litres of pure diatom oil will be available for study. In studying geothermal gradients the highest well structurally in the Artesia Field, New Mexico, showed a temperature increase of 1° F. per 111·2 ft. as the oil sand is approached, and the

lowest well 1° F. per 137·9 ft. Other wells showed 1° F. in 133·6 ft. and 1° F. in 133 ft. G. S.

760. Radioactivity as an Aid to Petroleum Discovery. *Petr. Times*, 1927, xviii. (458), 788.

Werner's geothermal method for oil prospecting has been criticised, although the basic fact that rock temperatures over oil sands is above normal has not been disputed. Gaedicke (*Allegemeine Österr. Chem. Tech. Zeit.*, Sept. 1) attempts to prove that the high temperature is not due to oxidation but to the decomposition of radium and the consequent emanations therefrom. Gaedicke's explanation of the increase in temperature is that beta and gamma rays from the decomposition of radium, or correctly, uranium, are the direct cause. Gamma rays decompose water and produce hydrogen, which he maintains goes to form hydrocarbons by direct combination with carbon. The carbon source is probably carbon in plant and animal organisms. While admitting that his idea is partly theoretical, Gaedicke suggests that it can be practically employed in the search for oil in conjunction with Werner's suggestion of earth temperature measurement. G. S.

See also Abstracts Nos. 645 and 762.

Coal and Shale.

761. Low-Temperature Distillation of Coal. R. H. Crozier. *Petr. Times*, 1927, xviii., 593–5, 687–9, 837–8.

After a brief discussion of the technical aspect of low-temperature carbonisation as regards the type of coal to be distilled, the nature of the plant best suited for differing raw materials, briquetting, etc., an account is given of the operation of the author's experimental plant at Wembley. A New Zealand lignite containing 13·8 per cent. water, 36·7 per cent. volatile matter, 37·5 per cent. fixed carbon and 12·0 per cent. ash was charged to the retort at a rate varying between 3·5 and 6·25 tons per day, the temperature at the bottom of the retort being 630° C. The yields of products were :—Semi-coke, 56·2 per cent. of coal charged ; tar, 24·85 gallons ; and gas, 9000 cubic feet per ton of coal. The coke contained 25·5 per cent. ash, 65·2 per cent. fixed carbon, and 9·0 per cent. volatile matter ; it contained a large percentage of fines and was somewhat fragile but burned readily with a clear, bright flame. The gas was of high calorific value, and it is calculated that a commercial retort will be capable of being maintained in operation by utilising 60 per cent. of the gas make. The tar was recovered from the plant in four fractions—(*a*) 0·7 per cent. of total tar, sp. g. 0·910 ; (*b*) 19·1 per cent., sp. g. 0·9574 ; (*c*) 22·5 per cent., sp. g. 0·980 ; (*d*) 57·7 per cent., sp. g. 1·02. An average sample of the bulked fractions gave B.P. 75° C., 75°–130° C. 1·23 per cent ; 130°–175° C., 4·20 per cent ; 175°–250° C., 25·16 per cent ; 250°–300° C., 18·78 per cent. ; 300°–360° C., 30·49 per cent. ; over 360°, 20·13 per cent. The recovery of tar was equal to 92·04 per cent. of the average oil content of the coal as determined in a laboratory apparatus. Five gallons of the crude tar were divided into five fractions by distillation and refining with sulphuric acid and caustic soda adopted. Fractions A and B, b.p. 75°–175° C., were combined, washed with 2 per cent. of acid and 0·5 per cent. of caustic soda, the acid and alkali tars being 4·83 per cent. and 3·6 per cent respectively of the fraction. Fraction C, b.p. 175°–250° C., gave acid- and soda-tar losses of 13·5 per cent. and 13·2 per cent. when washed with 2·5 per cent. and 2 per cent. of acid and soda respectively. Fractions D and E combined, b.p. 250°– 350° C., were treated with 3 per cent. of acid, the loss being 14·73 per

cent. Fractions C and D E were subsequently distilled over caustic soda. The yields of refined materials, calculated on the crude tar, were :—No. 1 spirit, 46°–130° C., 2·2 per cent.; No. 2 spirit, 130°–175° C., 3·1 per cent.; No. 1 Burning oil, 175–250° C., 18·1 per cent.; No. 2 Burning oil, 250°–300° C., 14·4 per cent.; Heavy oil and Paraffin, 300°–360° C., 30·0 per cent.

Balance-sheets which follow indicate that the profits to be anticipated per annum on 100, 200 and 300 tons per day plant would be £10,200, £30,300 and £51,990 respectively. The retort at Wembley is a vertical, flat-sided cylinder with semi-circular ends, the sides being made of cast metal plates of standardised sections securely braced by means of diagonal flues which traverse the apparatus. The whole is enclosed in brickwork to allow of external heating, fire-tile partitions being included so that the combustion gases frequently encircle the retort and pass through each of the transverse flues. The coal is fed in continuously at the top, the semi-coke falling into a hopper where it is cooled by steam, the latter then rising through the retort. The vapours and gases are withdrawn at four different levels into a condensing system which operates mechanically and fractionates the tar.

H. G. S.

762. Mode of Occurrence of Dopplerite: An Unusual Constituent of Peat. W. Francis and F. V. Tideswell. *Fuel*, 1927, 6, 516–521.

Dopplerite is a black jelly occasionally found in peat bogs in Germany, Austria, Switzerland and more recently Ireland. It is devoid of structure and chemically consists of ulmins, similar to those distributed through and forming a large part of most peats, in an almost pure form. Various hypotheses that have been advanced to account for its appearance are, briefly :—(*a*) Complete bacterial decomposition and ulmification of vegetable matter. (*b*) Deposition from solution of peat ulmins leached out from the peat and later precipitated by chance acidification or coagulation. (*c*) Formation of dopplerite masses by ulmin formation in situ from interacting solutions of amino-acids and carbohydrates produced from the accumulated vegetable matter by bacterial action. (*d*) Complete ulmification in situ of woody tissues. Chemical examination being insufficient to permit of a choice between the various hypotheses, a close examination of the actual conditions of occurrence of dopplerite in Ireland were therefore made.

Sluggan Bog, County Antrim.—The peat deposit comprised (1) a layer from 6 to 10 ft. thickness of old dark peat overlying the boulder clay. This was rich in woody fragments, twigs, roots and leaves, many of the fragments of wood having the appearance of having been charred, and many stumps were covered with a fine white powder, apparently resin. (2) An upper layer, 4 to 6 ft. thick of recent sphagnum peat substantially free from woody remains. Dopplerite was found about the middle of the north face of the block of peat, as a jelly, apparently filling a crack from near the top of the dark peat to near the bottom and terminating on and about a branch of a tree which was not itself converted into dopplerite. No evidence was found of a transition of wood into dopplerite (excepting jelly-infilted husks of twigs and reeds capable of other explanation), and it was not possible to reach any definite conclusions.

Bawnaughra Bog, County Leix.—The deposit was a dark peat about 6 ft. thick overlying the boulder clay. Wood was occasionally present but not generally distributed. Dopplerite was found in the clay almost uniformly 1 ft. below the peat, in veins and in nodules. The evidence supported the view that the dopplerite had flowed or been squeezed into position filling voids arising through various agencies, such as complete decay or loss of interior by stems or bulbous roots.

Derry's Bog, Garycastle.—The dopplerite lay in small deposits at the base of the bog about 14 ft. down both in the peat and in the clay. Typical observations were—infilling stems of reeds, filling voids and adhering to birch twigs, the intervening bark being generally intact. No evidence of transition of wood into dopplerite was found.

Benbow Bog, County Leitrim.—Cracks in this bog were opened up and from two a black fluid issued as though dopplerite was being dissolved by water. A third fissure yielded a very wet dopplerite, while a fourth showed a good deposit in the form of a quivering jelly.

Conclusions.—The evidence collected supports the view that dopplerite represents segregated peat ulmins deposited from solution. No evidence of conversion of wood in situ into dopplerite was observed, the boundary between wood and dopplerite being always sharply defined. The means whereby the ulmin solution or hydrosol was coagulated or precipitated is still indefinite. H. S. G.

763. Oil Shale Industry of Esthonia. Kogerman. *Petr. Times*, November 12, 1927.

During the past six years the mining of shale in Esthonia has increased from 9648—427,679 tons, being mined both by the State and private enterprise. These shales occur in the Middle-Ordovician strata, the whole formation attaining a total average thickness of 2·2 metres over an area of about 2400 square kilometres. It is estimated that over the 2400 square kilometres the oil shale reserve amounts to 5,000,000,000 tons, but it is anticipated that, taking into account the unexplored areas, there are another 500,000,000 tons. The oil shale strata in Esthonia show an almost uninterrupted geological structure, and only thin out towards the west. The colour of the oil shale varies from greenish-yellow to reddish-brown.

Although the shale cannot be profitably burned in fire grates of the ordinary type, the local portland cement factories have used it with success in grates of the semi-producer type, fitted to their boilers.

The average yields from the shale are :—

Crude oil	42% of sp. gr. 0·9545
Water free oil	40·8%
Gas	12%

The average total volatile matter is 54 per cent.

Hydrogenation experiments have led to the following conclusions: (1) that this treatment does not materially increase the amount of oil; (2) the hydrogenated oil contained more light oil; (3) the amount of phenolic bodies decreased considerably; (4) the crude oil from hydrogenation yields high grade light and motor oils.

Four experimental types of retorts are working, namely, a modified vertical Scottish retort which proved uneconomical while yielding 15 per cent. of oil; a producer type of German make, which has been redesigned since its installation and gives 20 per cent. of oil; and a fusion retort by Vickers giving 50—60 galls. per ton of dry shale.

The following constants of the oil, divided into two fractions, have been obtained :—

Specific gravity at 15° C. ..	0·8462	0·9273
Sulphur	0·93%	0·93%
Calorific value	18,640 B.Th.U.	18,640 B.Th.U.
Flash point	56° F.	101° F.
Fractionation—		
Up to 170° C.	60·25	14·1
170—230° C.	17·0	15·4
230—360° C.	12·5	52·5

Results of cracking experiments show that the oils do not lend themselves to cracking on the fuel oil basis, and that while the coke production is high it is of high quality suitable for fuel or metallurgical purposes. The rate of gas formation is high, the calorific value being 1300 B.Th.U./cub. ft. Using 8—12 lb. of 66° Bé sulphuric acid, a non-corrosive, stable and sweet spirit is obtained of exceedingly marked anti-knock value, and of the following composition :—

(Two samples compared with U.S. shale).

	Esthonian Shales.		U.S. Green River Shale.
Unsaturated hydrocarbons ..	30·5	21·3	20·1
Aromatic hydrocarbons	44·2	37·4	24·9
Naphthene hydrocarbons ..	8·6	11·3	6·2
Ricardo's compression ratio ..	6·43	6·19	5·78

A. R. S.

764. Technical and Economic Considerations on Coal Refining with Special Consideration of the High Pressure Process. Dr. C. Krauch, Director of the I.-G. Dye Industry, A.-G. (*Concluded.*) *Petr. Zeit.*, October 10, 1927.

The layer of finely ground coal 2 m. or more deep, which is present at the bottom of a *gas-generator* is kept constantly in motion by means of the gasification medium. The freshly introduced coal (on account of its liquid-like condition) mixes immediately with the red-hot coal and comes into intimate contact with the gasification medium; any pulverised coal and admixed dust which has not been gasified by glowing coal layers can still be completely gasified by blowing air directly over the surfaces.

The gases leave the gas generator above at a temperature of about 1000° and their "sensible" heat is utilised in the manufacture of crude brown coal which is dried before introduction into the generator. The latter, containing 50 per cent. H_2O is led into the gas stream leaving the generator and drawn from this to a desiccating machine. It now contains 10 per cent. H_2O and is granulated. The gas cools to 250°.

The production of the gas generator working according to the fundamental idea is very high. With a shaft of 12 sq. cms. cross-section, 750 tons of crude brown coal can be treated with generator gas in 24 hours. In the new gas generator, our pulverised brown coal is treated directly with H_2O from the Geisel valley. Meanwhile, the hot blast falls upon the generator gas which is available for the working of gas machines. The thermal effect of the new generator is very favourable, as its "sensible" heat is utilised in the drying and heating of fresh fuel. Losses by radiation are relatively small as also costs of plant and gasifiers. We are considering the wholesale application of this process in "Leuna."

In the production of N_2 compounds by way of NH_3 the third phase, *i.e.*, conversion of NH_3 into solid manures, is important, as it causes a great increase in the price of the bound N_2, a fact which is often insufficiently considered. Also it is not always possible to sell the whole German N_2 production in the form of the best known NH_3 manure salts, of $(NH_4)_2SO_4$. Recent statistics show that the annual N_2 consumption is 70 per cent. higher in Germany now than the pre-war consumption. The German production 1926–27 amounted to 550,000 tons, of which I.-G. produced 480,000 tons. The demands for N_2 were predominantly covered on the introduction of

Chile saltpetre, and the consumption of N_2 in the agricultural industry was steadily increasing. As a result of our researches we have arrived at a series of N_2 products containing N_2 as NH_3 or in the form of saltpetre or amides, also in other forms and likewise both of the other principal nutriments of plants, potash and phosphoric acid. From ammonium sulphate we arrive at the classical ammonium nitrate, thence at ammonium chloride, we have oxidised NH_3 catalytically and produced nitric acid, nitre, calcium nitrate, potassium ammonium saltpetre and "Leuna" saltpetre, and obtained manures synthetically from NH_3 and CO arising in the production of H_2 by means of a high-pressure process. Finally we have considered the production of phosphoric acid and introduced commercially manure media diammonium phosphate and nitrophosphate containing both N_2 and phosphoric acid.

Thus the production of such a large number of nitrates and research on agricultural and technical questions has caused the price of N_2 to increase considerably. The lasting improvement of our processes and the increased production have enabled us to decrease the price of N_2 during the last year. This is shown by the following table.: 1 kg. N_2 costs :—

	1913.	1924–25.	1925–26.	1926–27.	
		Marks.			Remarks.
Chile saltpetre ..	1·37	1·45	1·48	1·41—1·74	Carriage free to Hamburg.
Sodium saltpetre (Bad. An.-u. Soda Fabrik)	—	1·30	1·30	1·25	Carriage free to all German stations
"Norge" saltpetre .. (free Hamburg)	1·34	—	1·62	1·41	Spring, 1926, c.i.f. Danish ports.
Calcium saltpetre (Bad. An.-u. Soda Fabrik)	—	—	1·20	1·15	Free at station received.
Ammonium sulphate . (carriage free)	1·32	1·10	1·04	0·96	Carriage free as sod. saltpetre (Bad. An. u. Soda Fabrik).

II. *Coal Refining for the Purpose of Producing Liquid Fuels.*

It need not be mentioned here what has been achieved by the dry distillation of coal. In following up the slow-combustion of brown coal, together with the coking of coal at high and low temperatures, an extended application of the former has shown that it is not successful to build a slow combustion oven which produces a satisfactory yield of liquid distillation products, *i.e.*, of slow combustion tar, and which can be worked well for valuable trade products, especially benzine, and on the other hand no sufficient deposit is present for slow combustion coke.

Before the war the Bad. Anilin and Soda-Fabrik showed that it was possible, by means of the NH_3 synthesis, to combine carbon monoxide and hydrogen, *i.e.*, water gas, under high pressure and at high temperatures. It was established in 1913 that when certain catalysts, *e.g.*, nickel, platinum, palladium and other types of contact masses were applied, a petroleum-like product was obtained consisting of hydrocarbons, methyl alcohol and higher alcohols, also aldehydes, ketones and acids according to the catalyst and experimental conditions. This was patented, but the economic prospects of the new synthesis did not appear to be favourable since *individual products*

were not obtained. In the early part of 1923 the I.-G. dye firm found conditions under which MeOH could be obtained exclusively from CO and H_2, also from CO_2 and H_2. The reaction was also conducted so that plentiful higher alcohols, especially isobutyl alcohol, were formed, and a further change in the process yielded almost exclusively hydrocarbons. Research in this direction was carried out at the Leuna works in the summer of 1923. Considerable difficulties were contended at first in the construction of the high-pressure oven, since the reaction space had to be kept free from iron and similar metals which could form metal-carbonyls with CO, and these carbonyls attacked the contact substance causing the CO and H_2 to react in another direction. Large quantities of MeOH have been produced by the I.-G. firm. Isobutyl alcohol was produced technically in the manufacture of spirit. The Mülheimer Coal Research Institute in 1922 and 1923 was also interested in the catalytic treatment of CO and H_2 mixtures under high pressure.

F. Fischer and his collaborator succeeded in obtaining oxygen-containing hydrocarbon derivatives, but not individual products. They considered the mixture named "synthol," also the mixed hydrocarbons obtained therefrom by condensation named "synthin," to be valuable as fuels. They also discovered, during the last year, the conditions under which mixtures of various hydrocarbons of the aliphatic series from which lower gaseous members to solid paraffins are formed from benzine at atmospheric pressure. We are, however, of the opinion that it is better to work under pressure (as in our method), by which the same products can be obtained, and moreover, we are convinced that the application of pressure is preferable in the separation of volatile reaction products—apart from other advantages in the pressure process, *e.g.*, diminution of outlay.

It seems doubtful, at first, whether the production of hydrocarbons from CO and H_2 is the economic method for the conversion of coal into liquid fuel, since in the production of water gas, oxidation of coal into CO occurs first, and then this must again be suspended. Moreover H_2 is consumed and depreciated.

The direct hydration of coal for the production of liquid hydrocarbons by the hydration of CO appears to be economically better. *Berthelot* already showed in 1869 that when coal was treated with H_2 in the presence of reduction media, petroleum-like products were formed. However, this process was of no technical importance, since the HI utilised as reduction medium is very expensive. The method by which a technical and economic solution of the problem of coal hydration appears possible is described by Emil Fischer in 1912 in his original lecture at the K. Wilhelm Inst. for Coal Research at Mülheim. He says, "One asks, what effect has the change of pressure on the coking? What is obtained on the one side by distillation in vacuum and on the other side by pressure distillation in the presence of steam or H_2?" Also *re* the manufacture of brown coal, he says, "The idea of attempting the coking in a stream of H_2 (where possible in the presence of a catalyst) with a view to increasing the quantity of liquid hydrocarbons formed, may be more effective with brown coal than with pit coal.

The production of liquid products by the direct action of H_2 on coals of varied origin was successfully achieved by Bergius in 1913. The process which he had elaborated in numerous series of experiments consisted in pumping finely divided coal suspended in oil in the form of a paste into a high-pressure vessel in which it is treated with H_2 under high pressure at 400°—500°; the best temperature margin is very narrow and it increases with the types of coal treated. The coal thus yields principally a tar-like product together with an oil and a residue containing carbon, gas,

water and some ammonia. According to Bergius' own results, he obtained as end-products from 1 ton of dry coking coal with 6 per cent. ash :—

150 kg. motor fuel (boiling limit 30—230°).
200 ,, Diesel oil.
60 ,, lubricating oil.
80 ,, heating oil.
240 ,, coke (with ash).
5 ,, NH_3.

The Bergius process has found no practical application up to now, but Bergius has carried out the process technically on a small scale with a series of co-workers in a large research institute in Rheinau, near Mannheim.

The Bad. Anilin and Soda-Fabrik has worked for some years on the problem of the hydration of coal. We aimed at finding the conditions under which coal (which is to be considered according to more recent ideas as an extraordinarily complicated mixture of chemical compounds) yielded on hydration definite products in excessive amounts. It is clear that a liquefaction of coal will be the more economic, the more the production of undesirable secondary products which are difficult to value, can be suppressed against the desirable products. Our particular object was achieved on the production of low-boiling hydrocarbons of the aliphatic and aromatic series. In order to hydrate coal it is necessary to heat to a temperature at which the molecular complex present in its large molecules can be split. The fragments thus arising, which are mostly very unstable and can further decompose on the one side by splitting off H_2, and on the other side by condensation at the temperature in question into new stable compounds (this being the process of the usual coking) are now hydrated in the presence of H_2 under pressure. Various phases of the hydration process result according to the prevailing conditions, *e.g.*, temperature, H_2 pressure, velocity of flow of H_2, and especially of different catalysts which are applied according to the desired result.

Working without catalysts like Bergius, thus obtaining definite hydration products according to the nature of the coal, we can control the involved rôle of the possible reactions in different directions (Wunsch). For instance, we can work so that simple volatile hydrocarbons arise as the principal production, and a more or less large quantity of the same aromatic nature is also present. This last is fundamentally valuable, since we are thus able to produce synthetic benzine which naturally contains constituents which prevent the so-called "knocking" in the motor—the latter troublesome phenomenon which must first be removed from many natural benzines by adding motyl. The process has been elaborated technically and the erection of a large research institute near the Leuna works has been commenced. The question of material for the high-pressure apparatus causes considerable difficulty. Solid masses have to be removed from the high-pressure oven, and the products to be treated are usually rich in sulphur. It is desired to produce, at Leuna, benzine and various valuable oils, especially lubricating oils, from crude brown coal.

We have further attempted the application of catalysts in conjunction with high pressure (Haber Bosch NH_3 synthesis), and have further applied reaction acceleration of a different type from catalysers, *i.e.*, electric fields and electrical discharges and radiant energy so as to develop technical processes.

At present the direct production of high-boiling oils from the crude petroleum at Wettbewerb exceeds the demand, but the benzine production

is much too small. However, this last disadvantage has been compensated by means of the thermal cracking of high-boiling into low-boiling oils.

The prices of crude oil in America have decreased 50 per cent. as a result of the excess production within the last year, but the prices of refined products have only been decreased slightly. German and English benzines are the lowest in price in Europe at present. However, the difference in price between these and those obtained by coal hydration is not great. In the latter the cost of coal which serves as initial material for the hydration is of relatively small importance. The cost of H_2 is more important in the NH_3 synthesis, whereas a cheap production of H_2 and complete control of high-pressure technique are absolutely essential for an economically successful coal hydration.

The hydration of coal is closely connected with the petroleum industry. By means of our process a greater yield of low-boiling products from high-boiling constituents of petroleum can be obtained than with the usual cracking. Also cracking and subsequent hydration appear to be promising.

The quantity of coal necessary for the hydration is relatively small. For instance, only about 2 per cent. of the pit coal supplied in Germany would have to be manufactured so as to cover the imports of mineral oil into Germany. Thus the question of abundant crude material offers no difficulties and our attention is directed to the economic aspect of the method of production. The most appropriate process is offered by nature herself in the living globular bacteria in the roots of the vegetable plants of the pea and bean order, which can form albumen directly from atmospheric N_2; thus it is possible to combine N_2 at ordinary pressure with living matter occurring at low temperature.

Conclusion.

Coal refining has aimed on the one side at the conversion of coal into liquid fuels, and further at the production of nitrate media from atmospheric N_2 by means of the synthesis of NH_3; the only costly initial substance which the latter industry requires is coal. The present condition of this problem within the I.-G. Dye Industry is described and also the views for further development discussed.

The Haber-Bosch synthesis of NH_3 from its elements is described as the particularly economic process for N_2 compounds, and the practicability of the process is treated in the light of prevailing technical difficulties. The production of the requisite gases (H_2 and N_2) and the conversion of NH_3 into solid manure salts are discussed and both factors are considered to a greater extent in the high pressure synthesis. On this basis the question is whether it is best to work with the least of the highest possible pressure so as to make the entire costs quite insignificant. Numerous technical improvements in the production of NH_3, also the manufacture of various further N_2 manure salts which the I.-G. dye industry has brought on the market, have led to an essential decrease in price to that of pre-war times; also an increased production has ensued, due to the increased demands of the agricultural industry.

In Part 2, the work of *coal liquefaction* is treated, whence after some short discussions on the process of the dry distillation of pit coal and brown coal, the research of the Badischen Anilin- and Soda-Fabrik is described, in which liquid products were obtained from coal by passing CO and H_2 over catalysts. In 1913, it was fundamentally established in Ludwigshafen that higher hydrocarbons than methane as well as oxygen-containing derivatives could arise (instead of CH_4 only as in previous experiments)

in the hydration of CO by the application of suitable catalysts; these works led to the synthesis of methanol, to the production of higher alcohols and of hydrocarbons as almost exclusive reaction products.

The direct hydration of coal is treated in a further paragraph. A short historical review leads to the works of Bergius in which it is shown that elementary H_2 is stored in coals of varied origin and thus liquid products are principally formed. The process of the I.-G. dye industry is described, which will now be tested on a large scale in one of the Leuna works. Definite desired products can be produced in excessive amounts in this process by the application of different types of catalysts. The question of the economy of the new method of production can be decided by means of the outlay in Leuna, also in the I.-G. dye industry, the reaction velocity of another type, *e.g.*, electric fields and discharges are sought for, and exact and definite radiation energy is to be applied in order to develop the process technically.

The lecture closes with a short discussion and vote of thanks to Dr. Krauch and the I.-G. Dye Industry for the recent valuable research on the subject of liquid fuels. W. H. T.

765. A Process and Apparatus for Low-Temperature Distillation. Bamag-Meguin Aktiengesellschaft and O. Heller. E.P. 268,745.

The apparatus consists of a horizontal drier of cylindrical section heated by flue gases and in which the charge material is initially present. From this it flows into one of two rotating drums filled with stationary refractory lagging and baffles, where due to the heated condition of the lining the distillation takes place. After suitable condensation the gases evolved are passed back through the rotary drum out of use at the time. A. R. S.

766. Conditions for Success of Low-Temperature Carbonisation. W. E. Davies. *Chem. Met. Eng.*, 1927, xxxiv., 480—2.

This paper deals with the economics of processes of low-temperature carbonisation of coal. H. G. S.

767. Distilling Solid Fuel. F. E. Hobson. E.P. 277,214. Jan. 10, 1927

A method for the destructive distillation of waste and bye-products of saw mills, coal mines, etc., consisting in the continuous feeding of the fuel mass in an annular stream into a closed retort and around a vertically reciprocating lowered gas collector centrally placed. The mass is progressively subjected to increasing temperature by indirect heating applied spirally to the exterior of the retort. The volatile elements are continuously withdrawn by suction, and the non-volatile residue continuously eliminated. Reference is made to the co-pending application No. 277,215. H. S. G.

768. Liquid Hydrocarbons from Coal, Tars, etc. I.G. Farbenindustrie Aktiengesellschaft. Frankfort. E.P. 277,273. Mar. 13, 1926. Conv., Mar. 14, 1925.

An improvement of the invention claimed in Specification No. 247,217 as modified by Specification No. 249,155 consisting of the employment, in the conversion of coal, tars, mineral oils and the like into hydrocarbons and derivatives thereof with reducing gases containing hydrogen and carbon oxides, or with other reducing gases, under pressure and at a high temperature, in an apparatus of which not only the hot surfaces, but also the less hot and cold parts coming into contact with the gases are made of a metal not reacting with carbon monoxide. H. S. G.

769. Carbonising Coal. F. Puening. E.P. 256,942. July 26, 1926. Conv., Aug. 13, 1925.

A method of carbonising carbonaceous material such as coal in which the amount of coal flowing in a stream to the carbonising means is in excess of the amount utilised, the excess being directed to a relatively cool zone and returned therefrom to be again fed to the carbonising means. Condensation of tar vapours in the cool zone is prevented by introducing clean tar free gases under slight pressure.

The apparatus comprises means for supplying a continuous stream of coal to receptacles heated to effect carbonisation of the coal, the quantity supplied being in excess of that which can be retained by the receptacles. The excess is led to a relatively cool zone and means are provided for returning it to the feeding end of the apparatus. Gases evolved during carbonisation are withdrawn from the apparatus diluted with dry tar-free gases in order to prevent mingling with the excess material.

The carbonising receptacles are formed as a plurality of corrugated riblike surfaces or shelves in the periphery of a central member having the surfaces inclined downwardly to the wall of the central member vertically arranged, means being provided for causing relative movement between the surfaces and the means serving to supply material thereto.

The central member is interiorly heated to heat the carbonising surfaces by conduction. The means supplying the carbonaceous material is formed as a chute ranged to deliver to a plurality of rotating discs scrapers being arranged to transfer the material therefrom to the carbonising surfaces, additional means being provided to guide excess material to a suitable receptacle.

H. S. G.

770. Improvements in and Relating to the Steam Distillation of Coal and the Like. Synthetic Ammonia and Nitrates, Ltd., and R. E. Slade. E.P. 278,577. Oct. 13, 1927.

Coal is distilled in superheated steam with or without the use of either external or other internal heating. The dirty steam from the retort is then cooled to a temperature well above its dewpoint by means of water in such amount that it is practically all vapourised, leaving the precipitated oils in a practically dry state.

The waste steam is then used for regeneration of low-pressure steam.

A. R. S.

See also Abstracts Nos. 644 and 693.

ABSTRACTS

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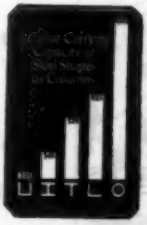

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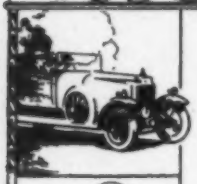

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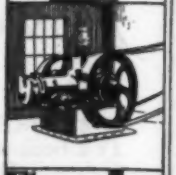

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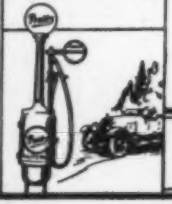

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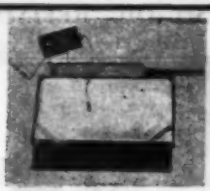

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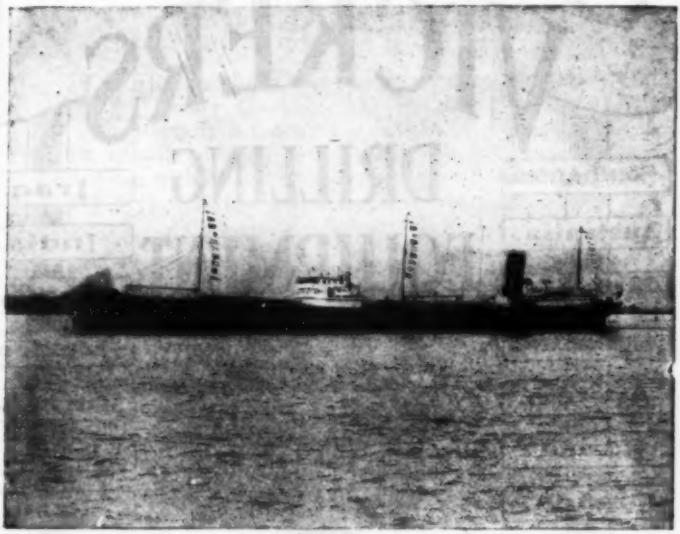

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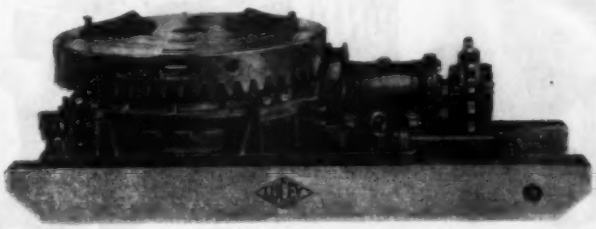

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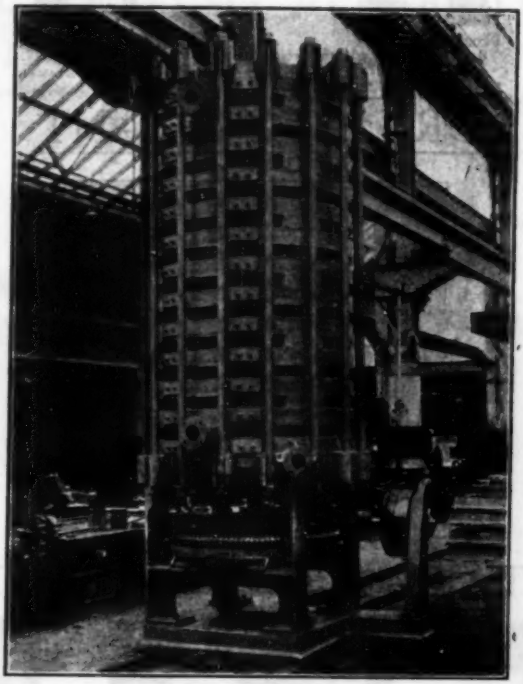

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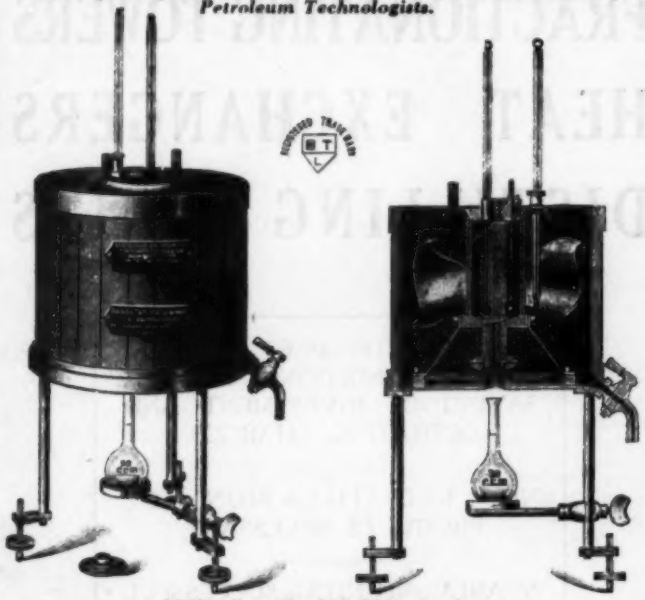

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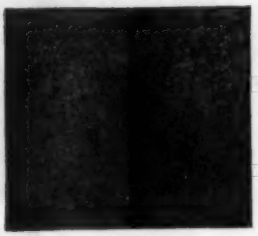
At Left: Sullivan Diamond Drills in Punjab, India.

Below: Sullivan Diamond Drills exploring for petroleum in British North Borneo.

In Borneo —and India, Sullivan Diamond Drills Bore for Oil



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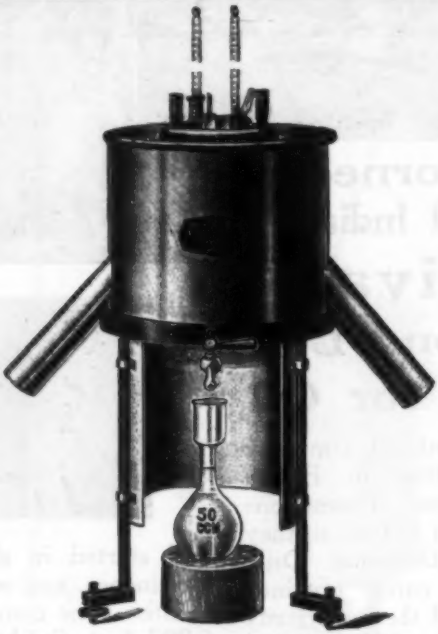

P.65. According to specification No. L.O.8 of The Standards Committee of The Institute of Petroleum Technologists.

The instrument is suitable for all oils exceeding 2,000 seconds in No. 1 instrument, time of outflow being one-tenth that of No. 1.

The above apparatus complete with Cup Cover, Graduated Flask, two Solid Stem Thermometers, enamelled back, graduated 30° F. to 150° F. in ½°, including National Physical Laboratory Certificate.

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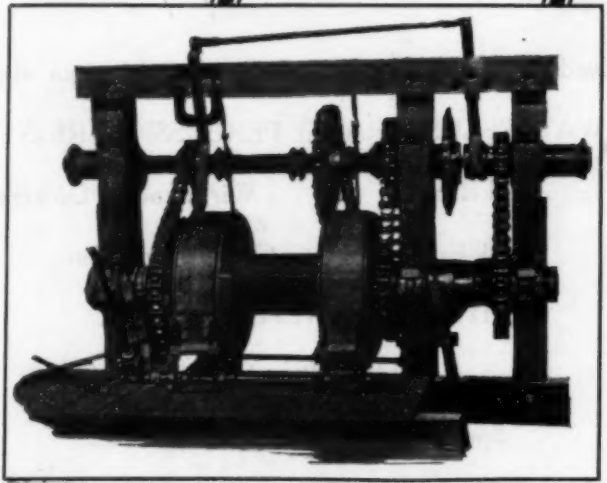

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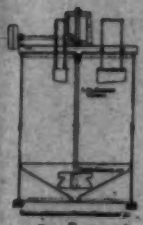

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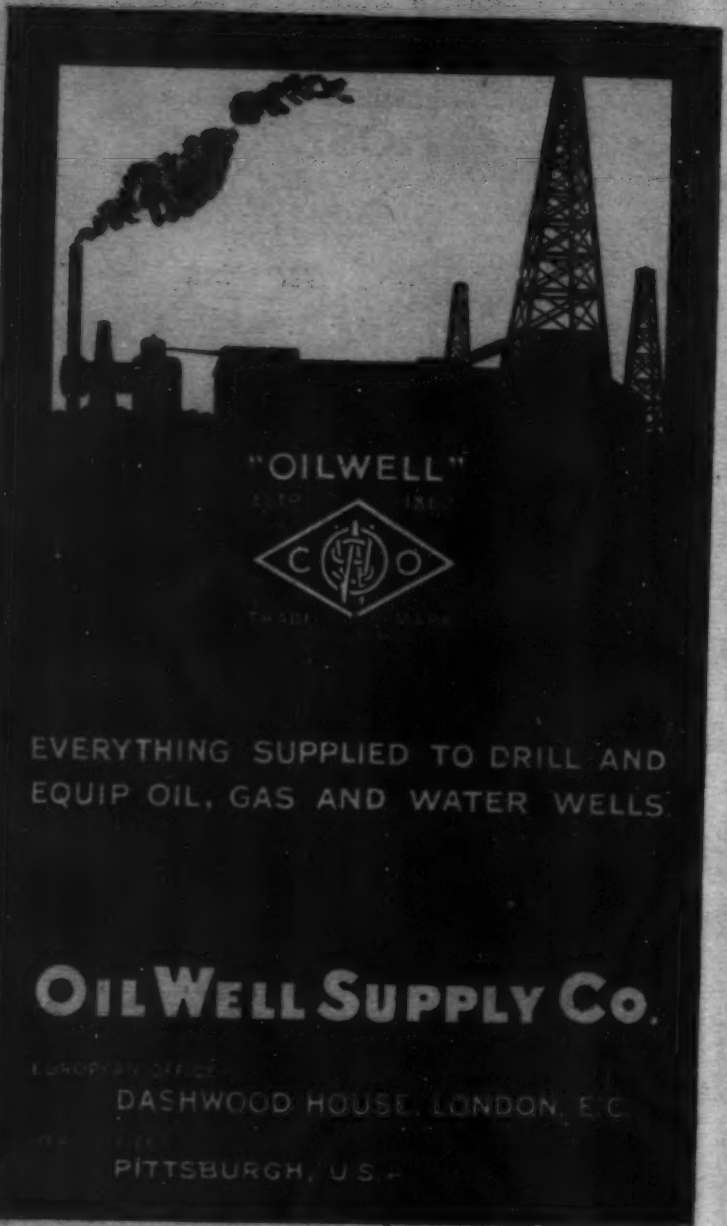

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